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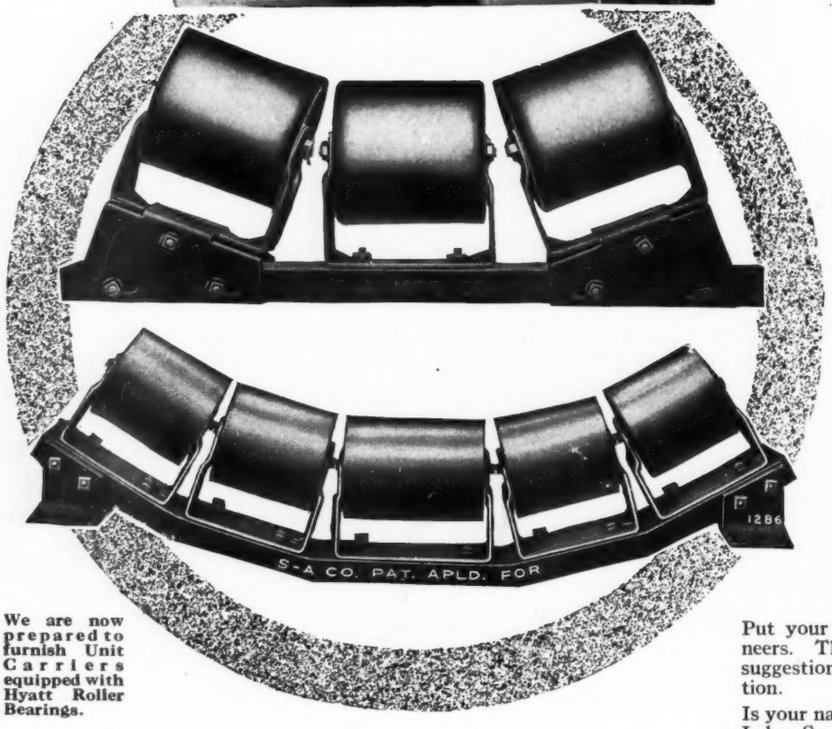

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Engineering and Mining Journal

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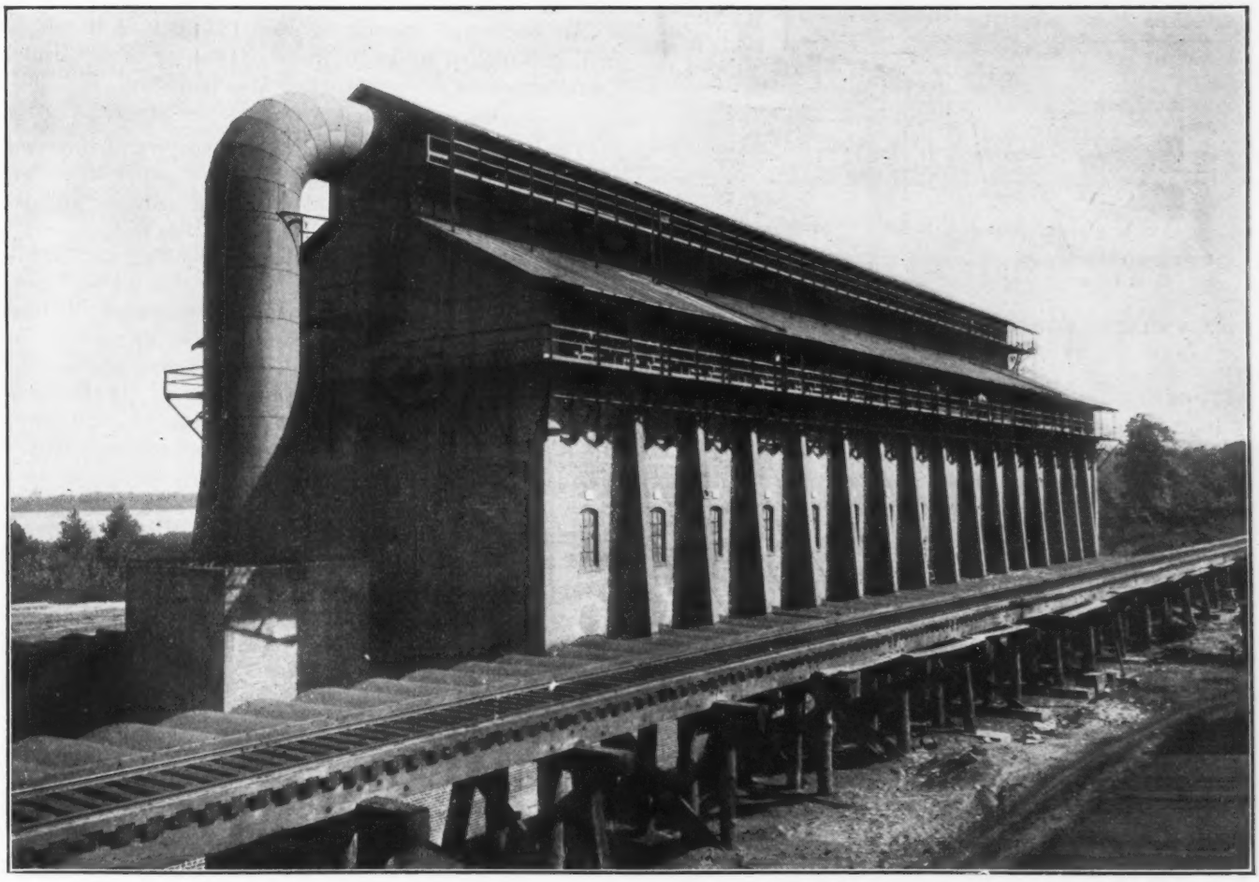
The Baghouse of the St. Joseph Lead Co.

By S. Paul Lindau*

SYNOPSIS—Detailed description of plant details and manner of shaking bags mechanically from outside of building. Cotton bags found to be more economical than woolen. Fume recovered per ton of charge averages 10.6 lb. Cadmium sulphide gives fine yellow dust on bottom when fume is sintered in baghouse chamber.

The baghouse was first introduced into lead-smelting practice in 1890 by Dr. M. W. Iles, superintendent and D. Sheedy, manager, of the Globe Smelting and Refining Co. of Denver, Colo. This was known as the Lewis & Bartlett process and was designed by Franz Cazin, mechanical engineer, of Denver. Although the principles and materials remain practically the same, many improvements in detail and application have been made. The two filtering mediums universally employed are either cotton or woolen bags.

The baghouse of the St. Joseph Lead Co. at Herculaneum, Mo., was designed by H. P. Saunders, engineer for the company in 1911, and was erected under his supervision. Previous to this time gases from the four 42x192-in. lead blast furnaces were permitted to escape directly into the atmosphere through short steel stacks over all the furnaces, consequently permitting all the entrained dust and fume to be lost.



BAGHOUSE AT THE ST. JOSEPH LEAD CO., HERCULANEUM, MO.

At present the gases are drawn from the furnaces by a No. 16 Sirocco blower, rated at 140,000 cu.ft. per min. through a 12-ft. balloon flue 600 ft. long, thence into a 14x14-ft. brick flue 70 ft. long and discharged (under a

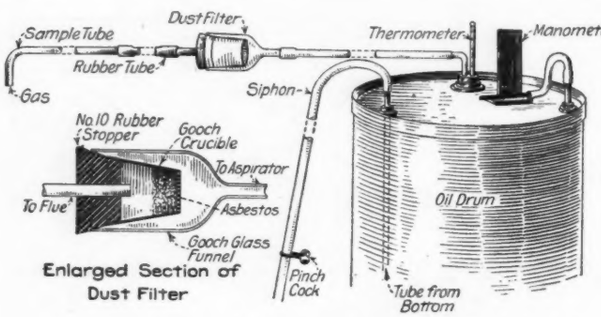
*Care of St. Joseph Lead Co., Herculaneum, Mo.

pressure of 2 to 2½ in. water) into an 18x12-ft. brick flue passing along the baghouse. The pressure depends on the amount of material in the bags. After passing through the bags, the gases are drawn through a central overhead rectangular steel flue 10x10 ft., which leads into a brick stack 350 ft. high and 20 ft. inside diameter.

The building is 216 ft. 6 in. long, 56 ft. 6 in. wide, and 60 ft. high from the floor to the discharge flue leading overhead. The brick walls are 21 in. thick at bottom, 17 in. in center and 13 in. at top. Additional strength is given by pilasters spaced every 13 and 14 ft. The roof is made of 2-in. plank covered with ⅞-in. boxing laid solid so as to break joints. This is covered with 5X elaterite roofing guarding against condensation of moisture which would drip down and soon destroy the bags.

The interior is divided into four compartments entirely separated by brick partitions having the same thickness as the walls. Below the thimble floor each compartment is subdivided into four chambers, separated by 13 in. thick and 16 ft. high brick partitions. These partitions are 12x53 ft. having a 3½x8 ft. iron door through which the dust is removed and loaded into railroad cars running alongside the building.

Each compartment of the four thimble floors contains 624 steel thimbles 16¾ in. diameter and 10 in. high;



APPARATUS FOR TAKING GAS SAMPLE AT LEAD BAGHOUSE

these thimbles are made of No. 14 gage ingot iron, beaded at the top for attaching the bag; they are spaced 24 in. apart and arranged as shown in the accompanying drawing. The thimble floor itself is made from No. 10 gage American ingot iron riveted together to make it as nearly gas-tight as possible.

The distributing flue is built of brick with 5-ft. jack-arch roof construction and connects with each of the 16 chambers by means of 42-in. disk-valve dampers. These dampers are made of cast iron, are operated by means of a $2\frac{7}{16}$-in. shaft running through the distributing flue, and are controlled by handwheel and screw.

The bags are made of cotton, either 8-oz. Osnaburg or seamless 48 woof and 48 warp. They are 18 in. diameter by 30 ft. long. The lower end is fastened over the thimbles by means of a strap and buckle (copper wire is equally as good); the other end is wired and hung by means of ¼-in. hooks to a shaft overhead, which runs directly over each row of thimbles; these shafts are connected to mechanical shakers and at stated intervals are given a shake by a special patented motion-device to dislodge the fume caught in the bags. The shakers are operated by 2-hp. motors, one for each chamber, thus doing away with the disagreeable features of hand-shaking. The motors are controlled from the ground by means of a switch. This mechanism was invented by Mr. Saunders, and patents are pending.

There is a total of 2496 bags having a filtering surface of 363,860 sq.ft., or about 3 sq.ft. per cu.ft. of gas per minute, when all are in use. Various types of bags have been tried, and those made of cotton with 48 threads per inch were found to give the best satisfaction in our case and cost from $1.90 to $3.05 each. The life of these varies from 8 to 18 months, depending on the nature and the temperature of the gas treated.

Woolen bags were tried and found to cost a trifle more in the long run. For a while some trouble was experienced with fires, which seemed to originate from a spark from the blast furnaces, setting fire to the dust in the brick flue and being drawn into the bags, and there is also some danger of spontaneous combustion if the dust is permitted to pile over 3 ft. high in the cha...bers. However, none have occurred for a year or more.

The temperature of the gases leaving the blast furnace is 200 to 260° F., reaching the bags at a temperature of from 120° to 180° F. depending principally upon the outside temperature and the number of furnaces in operation. In case they become too hot, atmospheric air is admitted through a door in the brick flue.

An analysis of gases in the baghouse is: O, 16%; CO, 1%; CO_2, 4%; SO_2, 0.75%; N, 71%. As yet no SO_3 has been detected.

An additional amount of about 120,000 cu.ft. of gas will be supplied to the baghouse as soon as the 16 Scotch hearths now under construction are completed.

Recovery and Analysis of Fume

For a period of twelve months the recovery of fume was 1460 tons, in which the lead recovered was 62%. The total weight of lead in fume was 1,810,400 lb. and the fume recovered per ton of charge was 10.6 lb.

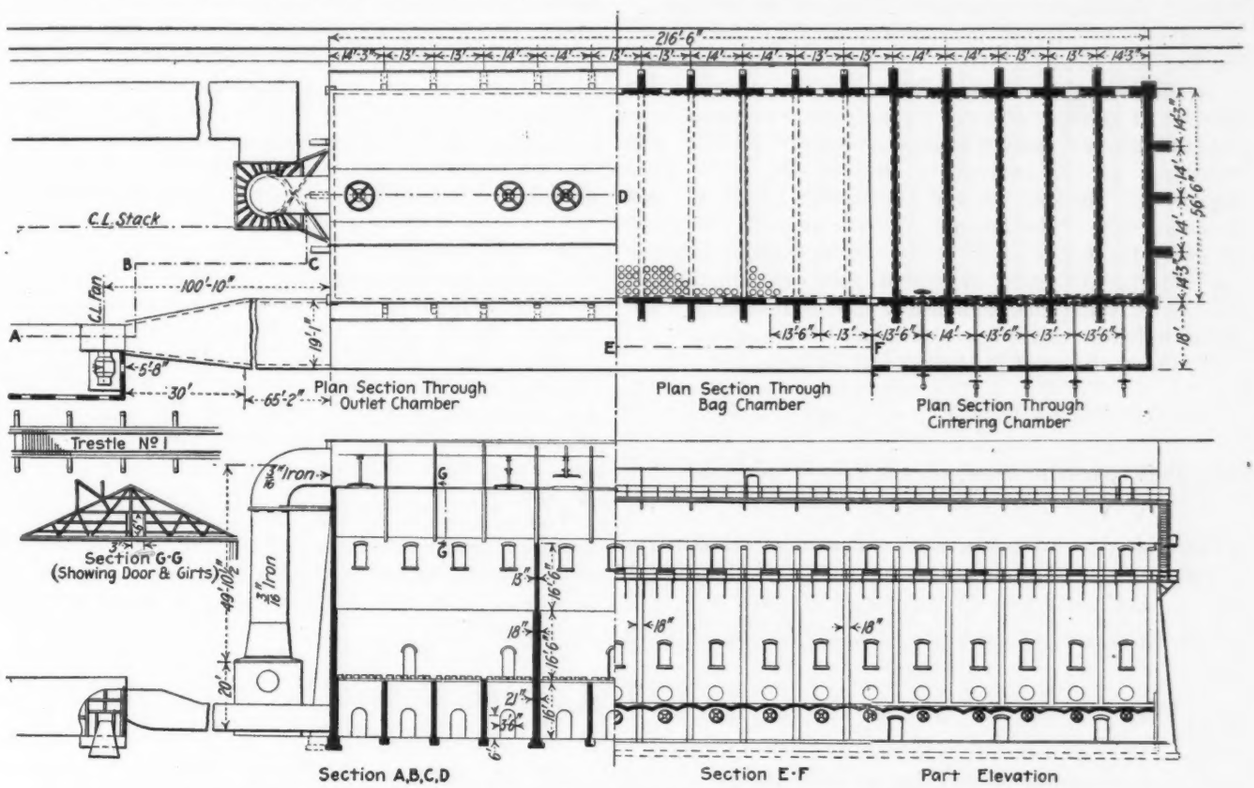
A typical analysis of this fume is: 63.8%, Pb; 9.28%, Cd; 3%, Zn; 0.2%, Fe; 1%, As and Sb; 0.1%, Insol.; 8.1% total S. Before cadmium accumulated in fume it analyzed: 75%, Pb; 0.30%, Cd; 2%, Zn; 0.3%, Fe; 1%, As and Sb; 0.15%, Insol. and 7.1% total S.

At present only three compartments of the baghouse are being used, although the bags are hung in the fourth in case they should be needed. One compartment is cleaned and thoroughly overhauled each week, necessary repairs being made at this time, and only the two remaining compartments are kept in operation; this means that each compartment will be in continuous use for two weeks between cleanings.

The bags in each compartment are examined once a week to detect any holes or detached bags. Also at the same intervals or more often if thought necessary, the escaping gases are sampled for lead, and if the saving is not over 97%, the cause is immediately sought for and removed. The average lead saving is from 98% to 100%. It has been found that with one bag off there will be a lead loss of about seven to nine tons per month. With two bags off the loss will be about double this amount; three bags off, about 18 tons per month. The reason for this can be plainly seen, as a very large proportion of the gas will rush through the openings where there is comparatively little resistance. Even a very small rent in a bag will cause considerable loss; this makes it necessary to keep a close tab on them.

The bags are shaken regularly every four hours. This is done by one man, who operates all the shaking in

chambers from alongside the distributing flue. Two chambers are closed at a time; mechanical shakers are started by throwing in a switch, and are run 2 min., which is sufficient time to shake all dust from the bags. The dust falls into chambers below, piling about 2½ ft. thick in two weeks, after which time the dampers leading into the chambers are closed, and the dust is ignited by means of lighted waste. Sufficient air is admitted through the doors and windows on the opposite side, to keep the temperature as low as possible and furnish oxygen for combustion. As a rule it takes about three days after setting fire to the dust, before the chambers can be cleaned. The sintered dust then has the appearance of lava, with a columnar structure, and is about 6 in. thick. It is shoveled into wheelbarrows, dumped into railroad cars and taken directly to the blast-furnace bins.



DETAILS IN ELEVATION, PLAN AND SECTION OF THE HERCULANEUM BAGHOUSE

On the bottom of the sintered fume there is usually about ½ in. of fine yellow dust, having very much the appearance of litharge. The analysis of this is: Pb, 58%; Zn, 7.5%; Cd, 20.9%; S, 7.1%. The CdS imparts the yellow color. The ore before being smelted contains only a very small percentage of cadmium, which accumulates in the baghouse. At present a method of extracting the cadmium is being investigated. After the sintered fume has been fed into the blast furnaces, the smoke is of a yellowish color; the yellow dust also appears on top of the molten slag and matte.

The following method is employed in detecting the lead losses without going into the baghouse. If carefully manipulated, this will give results accurate enough for all practical purposes. It will take about three hours to obtain and analyze the sample.

The apparatus consists of an oil drum of about 5 cu.ft. capacity, to be used as an aspirator; a porcelain Gootch crucible with about ½-in. asbestos fiber packed in the bottom for filtering purposes (moist glass wool will also do if tightly packed); a glass Gootch funnel about 6 mm. larger than the diameter of the Gootch crucible; a rubber hose and ¼-in. glass tubing, long enough to suit conditions (a 90-deg. bend is made at one end of glass tubing, as in sketch); a manometer, a thermometer and a pitot tube. The opening of sampling tube should be carefully measured and the area calculated. All connections should be air-tight.

To take the sample, the tank is filled with water, the apparatus being connected as shown in the accompanying sketch, and the opening in the sampling tube placed at the center of the flue, or where the average velocity has been determined with the pitot tube; this opening must face the flow of gas. The aspirator is then started, employing approximately the same velocity in the sampling tube as in the flue. It has been found that 5 ft., either way affects results but slightly. The time of taking a sample will vary from one to two hours, depending upon size of the opening in the sampling tube and the velocity of the gases.

If a large sample of gas is desired, two oil tanks may be used, switching alternately from one to the other. The manometer and the thermometer are read carefully, and the volume of gas is calculated by the amount of water aspirated.

If a large amount of dust and fume is carried in the gases, 3 cu.ft. of gas will give a sample sufficiently large. After the sample is collected, the sampling tube is withdrawn and the outside wiped off with a cloth or damp sponge. It is then disconnected, with the crucible, and both are taken to the laboratory. The asbestos is placed in a beaker. The inside of the tube and crucible are thor-

oughly washed with acid, followed by water, into the beaker containing the asbestos; this is boiled to get all the lead into solution, is then filtered and washed, and the amount of lead determined in the usual way; bichromate or electrolytic methods are more accurate on small amounts. The amount of lead is calculated in terms of tons per month for a basis for comparison.

When the presence of free SO_3 is to be detected, it can be determined from the same sample by drawing at least five liters of air through the apparatus after the sample has been taken, to expel the last trace of SO_2 from all parts of the apparatus; the asbestos is placed in the beaker, the sampling tube and crucible are washed with distilled water, and the contents added to it. This is filtered, thoroughly washed, a few drops of methyl orange added and is titrated with N/10, Na_2Co_3—1cc. N/10, $Na_2Co_3 = 0.0040$ gr. SO_3.

As lead is the only valuable metal in the gas, this method of determination is probably more accurate than catching a small amount of dust on a weighted filter and weighing, as the amount of lead in the dust varies somewhat. The lead loss and not the dust loss in our case is sought for. The amount of lead in dust and fume entering the baghouse is fairly constant while furnaces are running at normal conditions, so a determination of the gas entering the baghouse is always necessary when the escaping gases are being sampled.

The formulas used in the calculation are:

$$V_0 = \frac{V_1 \times 273 \times P}{(273 + T) \times 760} \qquad (1)$$

$$\textit{Grams Pb per liter or oz. per cu.ft.} = \frac{\textit{Gr. Pb in sample}}{V_0} \qquad (2)$$

(There happens to be the same commercial relation between ounces and grams as between cubic feet and liters.)

$$\textit{Estimated tons Pb per month 30 days} = \frac{\textit{oz. per cu.ft.} \times \textit{cu.ft. gas per min. main flue} \times 1{,}440 \times 30}{16 \times 2{,}000} \qquad (3)$$

where

V_1 = Volume water drawn from aspirator in liters;
V_0 = Volume gas at zero degrees C. in liters;
P = Barometric pressure;
T = Temperature of gas aspirated.

To settle the accuracy of this method, 40 determinations were made in one month on the gases before they entered the baghouse. The estimated tonnage was found to be only 7% lower than the amount of lead actually caught. The check may not always be so close, due to irregularity of the furnaces. These samples were taken while furnaces were running at normal conditions.

Copper-Pyrites Cinder Leaching

During a period of over one year 15 cargoes of copper-pyrites ore, of 1200 gross tons each, received at a smelting works on the Atlantic Seaboard, was handled separately from any other in hand and was calcined and the cinder weighed and sampled directly after removing from the sulphur burners. The lump ore averaged 3.095% copper. The returns by weight were 79% of the green ore. The copper content of the green ore was 78.4% of the copper in the lump cinder, which assayed 3.951% (this is a good check).

During a period extending over one year, eight cargoes of ore, both lump and fine, were taken from the burners and stacked in a shed open on all sides with porous sand bottoms, or were put on porous ground outside of the shed. The relative quantities outside and inside the shed and the length of the period of exposure were not noted, but the period of exposure was not less than 30 days. The percentage of copper in the ore was 82.1% of the copper content of the cinder, as against 78.4% in the case previously cited. The weight return was 76.1%, as against 79% when handled directly after calcining. The loss in copper percentage is to be attributed to leaching; the loss in weight is due to exposure, to wind and weathering (rain run-off) and to mechanical losses in handling several times, and particularly in cleaning up the ground when shipping.

It is a matter of common observation in the yards of chemical and smelting plants that during and after a heavy rainfall, before the rain has time to penetrate the ground, pools of water containing copper in solution are formed wherever there is cinder exposed. Some of this copper is cumulative, but most of it, particularly on more or less porous ground, is carried off in solution after each rainfall.

These conditions, especially when large tonnages are involved, emphasize the desirability from every point of view, of storing cinder in a different way from that now in use at most works. This could well be met by any of the following methods: Ore bins with a roof covering overhead; a closed shed with flooring; an open storage yard with concrete bottom and run-off for the rain water, filled with scrap iron to precipitate the copper in solution.

The objections to the ore bins if constructed, as usual, of timber, would be the fire risk, unless the cinder were allowed to get cold before dumping in the bins. The same holds true for the shed unless concrete floors were provided.

Damage Caused by Smoke or Fumes

By Arthur L. H. Street*

Passing upon a suit brought against the American Smelting and Refining Co. by the Riverside Dairy and Stock Farm to recover damages sustained by the latter through fumes passing over its property from the defendant's smeltery near Salt Lake City, the United States Circuit Court of Appeals, Eighth Circuit, lately declared that the measure of damages to growing crops injured by smeltery smoke and fumes is the excess of the market value of the crop that probably would have been raised but for the smoke and fumes above the market value of the crop actually raised, less any expenses in handling the crop saved by the injury. Damages in such a case cannot be based upon mere conjecture, but will not be disallowed merely because the amount of injury is not ascertainable with certainty and precision; it being sufficient that the damages may be approximated.

The court recognizes the rule that the complaining property owner in such cases is bound to use a reasonable degree of diligence to minimize his loss occasioned by the smoke and fumes, but is not bound to make extraordinary effort or expenditure, as by abandoning pasture land for dairy purposes. (236 Federal Reporter, 510.)

*Attorney at law, 829 Security Building, Minneapolis, Minn

Flotation at Pioche, Nevada*

An illustration of the possibilities of a combination of gravity and flotation processes on a complex mixed lead-zinc-iron sulphide ore is the plant of the Consolidated Nevada-Utah Co., at Pioche, Nev. The description of the ore, together with much of the data, was supplied by Mr. Van Wagenen, general superintendent.

The ore is a typical complex sulphide, consisting of pyrite, galena, sphalerite and chalcopyrite in a quartz matrix. The gangue is coarse quartz, but the vein carries fragments, large and small, of the quartzite hanging wall, cemented intimately by quartz amidst the ore proper. All the sulphides are distinctly crystalline; they are argentiferous in varying degree, the silver occurring both native and as argentite. Secondary sphalerite is present at certain horizons, and the carbonates are in evidence in increasing quantity upward from water level. By weight the vein as mined and milled is in the neighborhood of 50% sulphides. Zinc and silver are the principal metals of value.

TABLE I. COMPARISON OF LABORATORY TESTS WITH LARGE-SCALE OPERATIONS, CONSOLIDATED NEVADA-UTAH CORPORATION

	Mill Results, Aug. 14, 1916	Miniature on Daly of Aug. 14, 1916, Salt Lake City Water	Results Head Sample Mine Water	5-Ton Laboratory Test of Aug. 14, 1916	Miniature Results Prior to 5-Ton Laboratory Tests
Assay of heads, Zn. %	17.20	17.56	17.56	17.54	17.53
Assay of total zinc concentrates, Zn. %	41.80	40.48	40.17	42.41	41.91
Assay of total tils, Zn. %	5.60	4.89	4.89	3.64	4.71
Ratio of concentration	.....	2.91	2.81	2.87	2.94
Recovery of Zn in zinc concentrates	77.80	78.58	79.07	84.12	81.48
Assay of all table zinc concentrates, Zn %	42.60	40.63	40.63	41.32	41.77
Assay of flotation zinc concentrates, Zn %	37.00	39.80	38.52	46.77	43.19
Assay of zinc in total iron concentrates, Zn %	10.10	14.30	.....	12.88	10.06

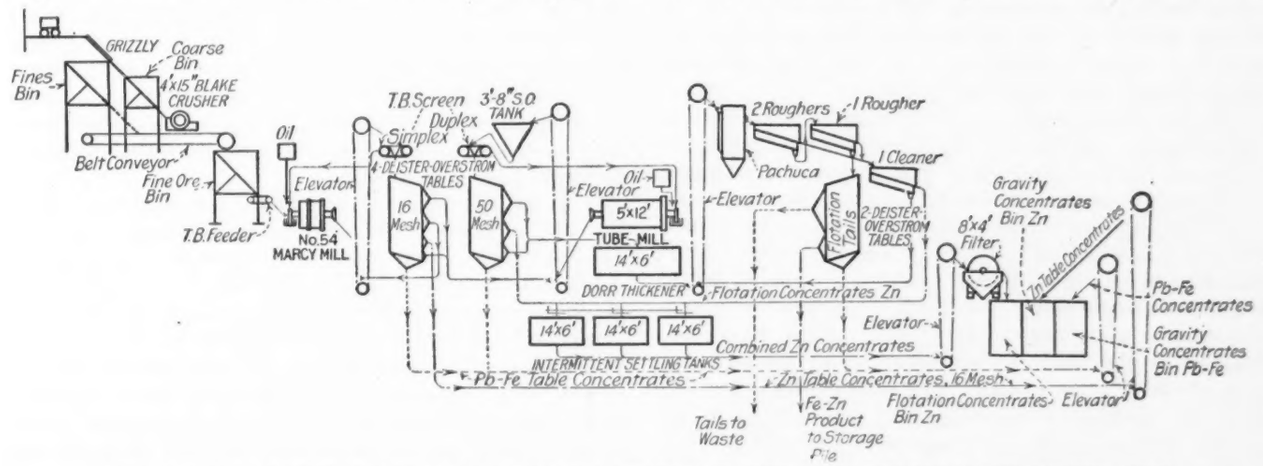
table for re-treating the flotation tails, and one extra flotation cell, so as to practice series treatment. Taking into account the complex mixture of the ore, the results, for a mechanical method, may be considered very satisfactory.

The mill water pumped from the mine has a temperature of from 100 to 120° F., and to find out if this was having any detrimental effect on the results, the mill was sampled at the vital points every half-hour for two days. A sample of the heads so obtained was sent to the General Engineering Co. A summary of the three results is given in Table 1, comparing the mine-water and Salt Lake hydrant-water tests on miniature machines (1000-gram charges) with mill results for the period, also comparing the preliminary miniature tests with the 5-ton test sample. The comparison speaks well for the reliability and value of miniature tests. The 6% difference in recovery might easily be accounted for by a difference in the samples, especially in the proportion of mine to dump ore in the 5-ton test of Apr. 15 and the ore milled in August, 1916.

All the essentials of the plant will be plain from a study of the flow sheet shown without further description. The output averages 53 tons per day. The power required for crushing and conveying material into the mill bin is 10 hp. for 8 hr., and for all other purposes 95 hp. for 24 hr., equivalent to 16 hp.-hr. or 34.5 kw.-hr. per ton.

A screen analysis of the final tailings made in July was as follows: +60-mesh, 2.6%; +100-mesh, 11.3%; +150-mesh, 20.3%; +200-mesh, 8.5%; —200-mesh, 57.3%.

Commercial results for the months of September and October, 1916, are given in epitomized form in Table 2.



FLOW SHEET OF THE AMALGAMATED PIOCHE MINES AND SMELTERS CORPORATION, PIOCHE, NEV.

A small lot of this ore was tested in the laboratory machine, while a 5-ton lot was tested by the General Engineering Co., which designed and built the commercial plant. The plant has been in operation since about Apr. 16, 1916. For the eight months elapsed since the initial start, the mill has run 87% of the total time. No material changes in the original flow sheet have been necessary, except the addition of one extra

Two standard Callow cells are used as roughers and one standard size for the re-treatment. All froth is cleaned in one-half size cell. The one re-treatment cell lowers the tails practically two units. For dropping lead, iron and insoluble, a special oil at one time was used, being made by adding one part H_2SO_4 to two parts of No. 33 gravity fuel oil. It has been discontinued. There is a tendency for the solutions to foul and kill the froth. At the first appearance of this condition the clear thickener overflow is turned into the tail race for about 30 min.; this is found to be more satisfactory and cheaper than the use of chemicals. The oil mixture now in use consists of 70% G. N. S. No. 28 (coal tar), 10% G.

*From a paper on "Flotation in 1916," by J. M. Callow, to be read at the February, 1917, meeting of the American Institute of Mining Engineers, New York.

N. S. No. 8, and 20% Pensacola No. 80. The coal tar (G. N. S. No. 28) is fed to the Marcy mill Adding tar to the pebble mill was only of slight value, while adding it to the Marcy mill lowered tailings about 1½ units. A mixture of No. 8 and No. 80 is added to the elevator, elevating flotation feed sufficient for frothing, No. 8 alone having been found best added to the rougher tails to give the desired froth on the second series.

The lead concentrate made originally was too "zinky" to market, so that it is now cut in two, making a lead concentrate and an iron concentrate. The former is marketed and the latter is piled up awaiting further treatment.

The lead concentrates assay approximately 0.42 oz. Au; 60 oz. Ag; 14%, Pb; 0.5%, Cu; 7%, Zn; 33%, Fe; 1.4%, Insoluble; 40%, S.

TABLE 2. COMMERCIAL ZINC RESULTS

September:	Tons	Gold	Silver	Lead	Zinc	Iron	Insoluble
Heads	1,567.9	.....	11.5	....	15.90	...	....
Concentrates	385.0	0.135	25.6	1.35	41.66	9.1	15.3
Tails	.....	.....	1.5	....	5.20	...	....
October:							
Heads	1,575.60	.....	9.00	....	15.70	...	....
Concentrates	495.00	0.10	19.95	1.34	42.45	9.75	11.5
Tails	.....	.....	1.10	....	5.30	...	....

The iron concentrates assay approximately: Au, 0.24; Ag, 30; Pb. 4; Cu, 0.30; Zn, 24; Fe, 33; Insoluble, 2.50; S, 40.

About 4% of the flotation feed consists of this latter material. The zinc and iron are in chemical combination. Floating this would mean an unsalable product, while dropping it means high tails.

For thickening the flotation concentrates prior to filter-pressing, three 6x14 tanks, fitted with Goldfield agitators, are used. Two would have been sufficient for the tonnage. These are run intermittently, the system being to fill, settle and decant in rotation. This is the same scheme as that used at the zinc plant of the Magma Copper Co., also in a recent installation at the Bingham and New Haven Copper and Gold Mining Co.

The filtering is done on a 4x6-ft. Portland filter, the capacity being sufficient so that the filter operates only about one-third of the time. The blow is set so that it operates just above the scraper; an overflow pipe prevents the pulp level from rising too high. A Gould wet-vacuum pump is used, giving an average vacuum of 17 in. The filter cake averages a thickness of about ¾ in., moisture seldom being above 8%. Filter concentrates are mixed with table concentrates, which have been drained in the bins, for shipment. Car samples vary from 5 to 9% in moisture. Mr. Van Wagenen says that this method of handling float concentrates is admirable and one of the best features of the mill.

When the canvas needs cleaning, a water connection is made to the air pipe and the canvas is rapidly cleaned simply by brushing.

Molybdenum and Its Ores

An investigation to ascertain why molybdenum in this country should remain undeveloped is reported in Bulletin 111 of the United States Bureau of Mines, called "Molybdenum, Its Ores and Their Concentration." A preliminary review of the situation showed that the market for molybdenum in alloy steels must be developed, or that new uses for the metal must be created before the demand will be sufficient to warrant any extensive mining of the ore.

One factor in retarding demand from the alloy-steel trade is that manufacturers who might use the metal are kept out of the market by the fear of not being able to obtain steady supplies. Those who might develop the extensive low-grade molybdenite or wulfenite deposits in this country are prevented by the small visible demand and the fear that a large production will overstock the market. Owing to these conditions the mining of molybdenum has in the past been confined almost entirely to small-scale operations on high-grade streaks of molybdenite ore, and the methods of recovery have been limited largely to cobbing and hand picking.

The problem before the Bureau of Mines in this instance was to ascertain the character and extent of the deposits of molybdenum ores in the United States from which supplies requisite for the development of the market might be obtained, and how the ores might best be concentrated into a marketable product and to prove to possible consumers of molybdenum that the element is not, as scarce as commonly supposed, and that there are in this country many deposits of low-grade ore from which large supplies may be derived. An additional purpose is to prove to producers of molybdenum that there is a latent market for their product in the alloy-steel trade, which needs only the assurance of steady supplies to make possible a considerable development.

Tungsten Deposits of Inyo County, California

The notable tungsten deposits near Bishop, the principal town of Owens Valley, California, are described in a report recently issued by the United States Geological Survey. These deposits are mined in Deep Cañon, which traverses an isolated group of hills at the base of the Sierra Nevada. Similar groups of hills farther south in Owens Valley are known by distinctive names, such as the Alabama Hills, and the name Tungsten Hills has been suggested for the group in which the principal tungsten deposits have been found.

Tungsten ore was first found in place in August, 1913, on the Jackrabbit claim, near the present center of mining activity. Three partners, who were mining placer gold in Deep Cañon, found that the concentrates they obtained were difficult to clean because the gold was accompanied by a heavy white mineral, which proved to be scheelite. When its identity and value became known, search for it was begun. At one place the scheelite is embedded in the blackish garnet rock in particles somewhat larger than those commonly found in the orebodies of the district, but it is neither so prominent nor so obviously recognizable that it would have been found had it not been the special object of search. The discovery that the scheelite occurs in the garnet rock, however, made prospecting for tungsten simple. The blackish garnet masses on the bare hills contrast with the prevailing gray and reddish granite and are therefore easily recognized.

The deposits, although found in 1913, remained practically unknown until the spring of 1916, when their development was energetically begun. The ore consists of scheelite, garnet, epidote, quartz, and other minerals. By midsummer two mills, having a total daily capacity of 400 tons, had been completed and were in active operation.

Utah Copper Co.

The report of the Utah Copper Co. for the fourth quarter of 1916 shows a production of 50,723,245 lb. of copper; 20,325,520 lb. in October, 16,421,192 lb. in November, and 13,976,553 lb. in December. The gross production for the whole year is 196,752,631 lb., making the average gross monthly production for the year 16,396,053 lb.

Ore milled during the last quarter was 2,846,600 tons, a daily average of 30,941 tons. Average assay was 1.4742% copper, and average extraction 60.44%. The low extraction is due partly to the fact that the ore contained some copper in form of carbonate, but principally to the unusually large tonnage milled, troubles with irregular ore supply and intermittent operations occasioned by bad weather and by alterations that are in progress in the three sections of the Arthur plant, and one section at Magna, for the purpose of increasing mill capacity.

Average cost per pound of net copper, after making allowance for smelter deductions and crediting miscellaneous income, including Bingham & Garfield Ry. Co. earnings, was 7.498c., as compared with 6.322c. for the third quarter, 6.726c. for the second quarter, and 7.19c. for the first quarter of 1916. The comparatively high cost for the last quarter of the year is due partly to bad weather and consequent decrease in tonnage during the last seven weeks, partly to the increased cost of supplies, and partly to the increase in wage scale which became effective Dec. 1.

Financial report for the quarter showed net profits from milling operations, $8,503,926; other income, $161,392; dividends from Nevada Consolidated, $1,500,750; dividends from Bingham & Garfield Ry. Co., $485,000. A total net profit of $10,651,068. Dividends amounting to $5,685,715 were paid, leaving net surplus of $4,965,353. Earnings for fourth quarter were computed on the basis of 26.487c. per lb. for copper. Regular dividend paid on Dec. 31 was at the rate of $10 per annum, plus an extra dividend of $1 per share, making a total of $3.50 per share for the quarter.

Ray Consolidated Copper Co.

The report of the Ray Consolidated Copper Co. for the last quarter of 1916 shows production of 21,651,956 lb. of copper; 7,302,817 lb. in October, 6,856,114 lb. in November and 7,493,025 lb. in December. In addition to copper from concentrating ore there was a total of 940,950 lb. produced from ore shipped direct to smelters, bringing gross production up to 22,592,906 lb.

Total ore milled during the quarter was 871,700 tons, averaging 1.649% copper, average mill extraction being 75.32%. Mill improvements, under way for more than a year, are still actively in progress and account for the high extraction and increased mill capacity, the latter now being about 25% greater than was contemplated in the design of the mill.

Average net cost of all copper produced for the quarter was 9.769c. per lb. including 12½c. per ton of ore milled for retirement of mine-development cost, and credits of income from Ray & Gila Valley R.R. revenue from gold and silver produced and all other miscellaneous income. Wage bonuses during the quarter amounted to more than 40% above regular scales.

Net profits for the quarter amounted to $3,583,516; miscellaneous income $8676, a total of $3,592,192. Dividends of $1,577,179 were paid, leaving net surplus of $2,015,013. Earnings for the quarter are based on price of 26.25c. per lb. for copper. The twelfth quarterly dividend of 75c. per share was paid, and an extra dividend of 25c. per share. Total dividends paid since beginning of the company's operations amount to $8,931,100, including those distributed for this quarter.

Chino Copper Co.

Report of the Chino Copper Co. for the fourth quarter of 1916 shows a total production of 20,578,021 lb. of copper; 6,921,081 lb. in October, 6,906,024 lb. in November, and 6,750,916 lb. in December. Total amount of ore treated was 790,000 tons, or an average of 8587 tons per day. Average copper content was 1.78%, and the recovery per ton of ore milled was 26.05 lb. of copper. In addition to the copper recovered by milling, 24,925 lb. was recovered from precipitation plants at the mine, making a total production from all sources for the fourth quarter of 20,602,946 lb. Cost of net copper produced for the quarter, after allowing for smelter deductions and crediting all miscellaneous income was 8.89c. per lb.

The net profit from copper production during the quarter was $3,347,640, and miscellaneous income was $81,336, making a total of $3,428,976. Dividends paid amounted to $2,174,950, leaving a net surplus of $1,254,026. The earnings for last quarter were based on 26.34c. per lb. for copper. The regular dividend of $1.50 per share, at the rate of $6 per annum, and an extra dividend of $1 per share was paid, making a total of $2.50 for the quarter.

During the quarter, 466,526 cu.yd. per month of material in place was removed by steam shovels. Of this, 985,659 was stripping, the remainder being equal to 791,743 tons of ore.

Foreign Trade in Copper

Exports of copper from the United States in December, 1916, are reported by the Department of Commerce as follows:

	Lb.
Ore and concentrates, contents	622,885
Unrefined, etc., in bars, pigs, etc	5,669,253
Refined bars, etc	56,824,321
Old and scrap	700
Plates and sheets	4,598,332
Wire	1,851,047
Total	69,566,538

The weight of ore exported in December was 7859 tons; of concentrates, 431 tons.

Imports of copper into the United States in December, 1916, are reported by the Department of Commerce as follows:

	Lb.
Ore and concentrates, contents	15,607,527
Matte, contents	1,751,510
Unrefined, etc., in bars, pigs, etc	19,139,626
Old, etc., for remanufacture	716,364
Composition, copper chief value	48,031
Total	37,263,125

Actual tonnage of copper-bearing material imported in December was 49,674 tons ore, 12,383 tons concentrates, and 2683 tons matte.

Revival of the Cerro Gordo Mines

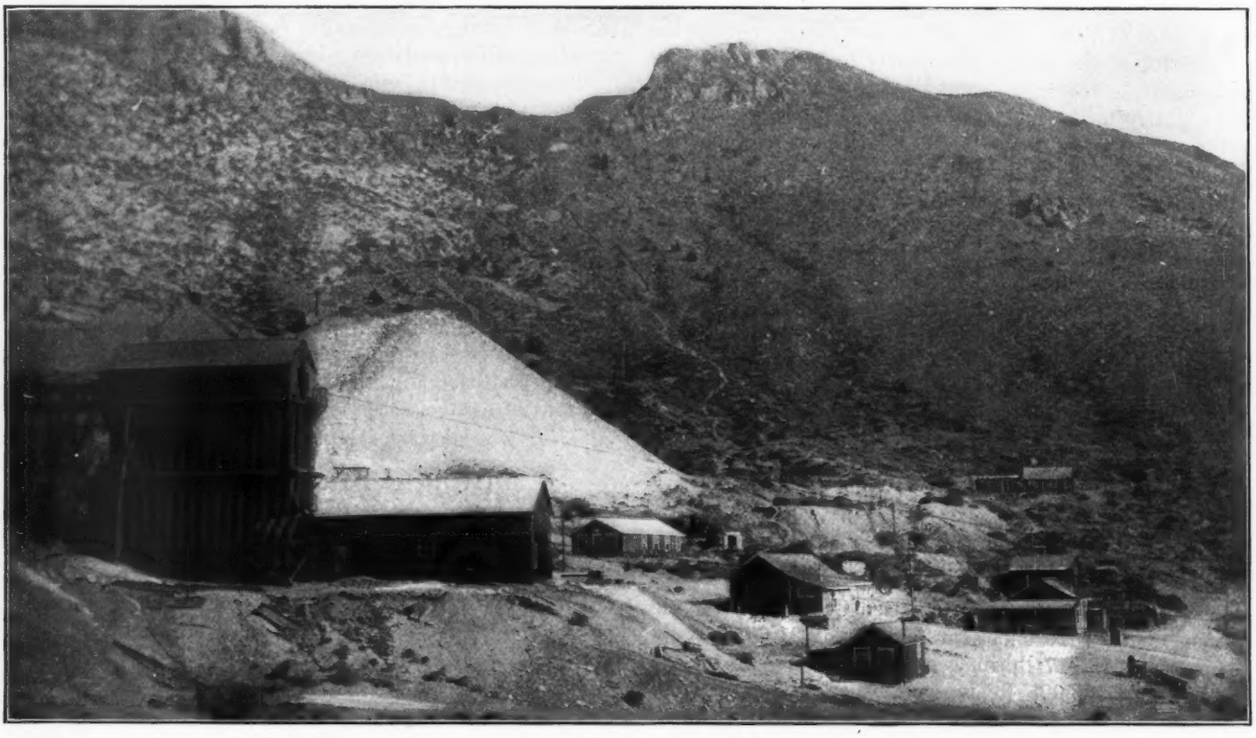
By Lewis H. Eddy*

SYNOPSIS—The Cerro Gordo mines, famous for a production of approximately $10,000,000 in early days by crude mining and smelting methods and a total production to date of $15,000,000, is a recent example of the revival of old properties in California. It was closed down in 1887 and for thirty years worked only by leasers, followed in 1907 by an unskillful attempt to resume deep mining. In 1911 it was reopened under lease and in 1915 became the property of the Cerro Gordo Mines Co. The revival is attributed to skillful application of modern mining methods.

The Cerro Gordo mine, at Keeler, Calif., reopened in 1911 after having been closed for about forty years, is now one of the largest producers of lead and silver in California. From Feb. 20, 1911, to Sept. 20, 1915, covering the period of actual work under the Cerro Gordo lease operated by Louis D. Gordon and associates, the total production of all ores amounted to 25,504 dry tons, having a total net smelting value of $713,278, or an average value of $28.72 per ton.

The Cerro Gordo Mines Co. was organized in June, 1914, assumed control at the expiration of the lease in September, 1915, and began active operation of the property as owner on Oct. 1, 1915. In the first 12 months of company operation the mine produced and shipped a total of 8195 dry tons of ore and 6547 dry tons of slag and flue dust valued at $236,687. In this period 7797 dry tons of zinc ore was produced, yielding 4,556,062 lb. of zinc; 398 dry tons of silver-lead ore, yielding 7 oz. gold, 9980 oz. silver, 21,669 lb. zinc and 295,489 lb. lead. From the proceeds of the first year of company operation a dividend of $25,000 was paid on Sept. 22, 1916, and a reserve fund of $50,000 was created, showing a total net profit of $118,000.

The Cerro Gordo mine, discovered by Pablo Flores in 1865, is situated in the western part of Inyo County, 5½ mi. by aërial gravity tramway and 8 mi. by wagon road northeast of Keeler, a railroad shipping point on the eastern shore of Owens Lake. The property includes the Newsboy, situated 1½ mi. farther southeast and the Swansea claims, 3 mi. north of Keeler. There are 8 patented lode claims and 33 unpatented lode claims in the Cerro Gordo group, and 3 in the Swansea. Pablo Flores and his Mexican associates worked the Cerro Gordo by surface mining, smelting the lead-silver ore in *vasos*, crude but substantial stone furnaces, built of local material and fired with charcoal fuel. Some of these *vasos* are still standing, though badly weathered by the storms of fifty years.



GENERAL VIEW AT THE CERRO GORDO MINES, KEELER, CALIF.

Beginning in 1868 some of California's pioneers operated the property. The first water-jacketed furnace introduced into the United States is said to have been installed at the Cerro Gordo. The complete plant included two slagging furnaces, two blast furnaces, rock crusher, blower, water-supply pipe line and other essential equipment. The mine was opened by a 900-ft. shaft and several tunnels. Large orebodies containing lead, silver, copper and gold were developed, but were believed

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to have been generally exhausted when, in 1887, the plant was destroyed by fire and the mine closed down. The owners, being apparently satisfied with a total production of $10,000,000 in ten years and unacquainted with the fault system so important in the geologic structure of California lode mines, abandoned the Cerro Gordo to venture in other fields. In that period the pig lead and silver produced in the Cerro Gordo furnaces and some of the silver-lead ore was hauled by mule teams a distance of 280 mi. to San Pedro, whence it was shipped by water to San Francisco and to Wales. The hauling of this product in the time of largest production required a freighting outfit which included 1500 mules and about 100 men. The production of the Cerro Gordo mine and the freighting business in the region became a large factor in keeping Los Angeles on the map.

For thirty years the mines were worked only by leasers, chiefly on surface stringers, the ore being treated by chlorination. The leasing was practically continuous year after year and the aggregate amount of lead, silver and gold produced in that period approximated $3,000,000. In 1907 the Four Metals Mining and Smelting Co. was organized. This company built a tramway of poor construction, shipped 5000 tons of slag from the old furnaces, mined about $30,000 worth of ore from the Newsboy and did a small amount of other mining, and finally got into financial and legal straits from which it was rescued by leasing the zinc orebodies in February, 1911, and extending the lease in February, 1912, to include all the ores.

Organization of Cerro Gordo Mines Co.

Exploration and development of the silver-lead and copper-gold orebodies followed immediately the extension of the lease, and with surprising results. A new steam-hoisting plant was installed and other essential equipment or repairs were added to the mining plant, including new ore bins, new camp buildings, new compressor, and rebuilding the aërial tramway from the mines to Keeler. The installation of complete electric power and lighting equipment soon followed. The Cerro Gordo Mines Co. was then organized, with Frank Hambly, of San Jose, as president and Louis D. Gordon, of San Francisco, as vice-president and general manager. James C. Climo, of Los Angeles, was retained as superintendent.

The Cerro Gordo and Newsboy groups are near the summit of Inyo Range, which is a southern extension of White Mountains, at an average elevation of 8600 ft. above sea level and 5031 ft. above the level of Owens Lake. The collar of the Belshaw shaft on the Cerro Gordo mine is at an elevation of 8506 ft. above sea level. Cerro Gordo Peak, about ½ mi. east of the mine shaft, has an elevation of 9217 ft. The present productive operation by the company is on the Cerro Gordo group, although sufficient exploration has been done on the Newsboy to place it in condition as a fine prospect.

The mine is operated through the Belshaw shaft, constituting the principal work of the original American owners. The shaft is vertical, two-compartment, 900 ft. deep with a 250-ft. winze, making a total depth of 1150 ft. The shaft has not been deepened since reopening the mine, as development work is continuously extending the known orebodies and exploration disclosing new ones.

Three auxiliary air hoists were in use in 1916. One is on the 200 level, hoisting out of the 252-ft. winze in the Jefferson orebody; the other two are situated on the 400 level and are used to lift zinc ore from winzes below the 400 level. A fourth air hoist was installed on the 400 level to sink a winze in the extension of the Jefferson orebody below the 400. The ore is hand-trammed in 16-cu.ft. Joshua Hendy floating-axle cars which carry about one ton of zinc ore, or 2500 lb. of lead ore.

The aërial tramway buckets are loaded direct from the bins. The tramway, built by A. Leschen & Sons Rope Co., St. Louis, Mo., delivers the ore at the rate of 120 tons in 8 hr. to the terminal station at Keeler, where it is dumped directly into bins provided with chutes that deliver the ore into narrow-gage cars of the Nevada & California R.R. This road is part of the Southern Pacific system connecting at Mina, Nev., with the standard-gage. The lead-silver ore is shipped to the United States Smelting Co. at Salt Lake, and the zinc ore goes to Kansas and Oklahoma.

Cadmium in Spelter

A brief paper on the subject of Cadmium in Spelter, by W. R. Ingalls, presented to the Institute of Metals (Great Britain) drew out some valuable contributions on the same subject, besides those of George C. Stone and the Bridgeport Brass Co. sent to the *Journal*.

R. T. Rolfe (Bedford) wrote that out of about one hundred complete analyses of different brasses published in the *Journal of the Institute of Metals*, not one mentioned cadmium, although very minute proportions of other elements were often recorded.

With regard to lead, the grading of spelters according to the amount of this impurity is most desirable. A hard and fast classification does not appear to obtain in this country, and what are described as good ordinary brands show a very large variation in the proportion of lead contained. Furthermore, different consignments of spelter of the same brand often vary in this manner to an undesirable degree.

The following results, among others, were obtained by the writer from different brands of spelter examined during the years 1913-16:

Brand	Date of Sampling	Lead, %	Iron, %
Revil	Sept. 19, 1912	0.46	0.07
Revil	Mar. 31, 1913	1.21	0.19
Nouvelle Montagne	April 17, 1913	0.94	0.03
Ste. de Boom	May 14, 1913	1.65	trace
S.S.	June 10, 1913	0.32	trace
De Boom	June 6, 1913	0.31	trace
Ste. de Boom	Sept. 15, 1913	2.03	trace
Vieille Montagne	Oct. 15, 1913	1.47	0.07
S.S.	Oct. 30, 1913	3.43	trace
Vieille Montagne	Oct. 26, 1914	1.49	0.04
Crown	Jan. 13, 1915	1.52	0.08
Vivian & Co.	Mar. 19, 1915	0.83	0.12
Vivian & Co.	May 19, 1915	1.32	0.08
Revil	Mar. 14, 1916	1.73	0.19

One of the brands contained, in addition, aluminum to the extent, usually, of about 0.30%, with some copper, and was probably a remelted spelter.

The samples analyzed were average ones from different consignments, taken at the dates given, and were obtained by drilling right through several plates (for example, 3 plates from a ½-ton lot of 31 plates and pro rata in the case of larger lots), the drillings being cut or otherwise separated into very small pieces, which were then thoroughly mixed together.

These spelters were bought at widely differing prices, over a long period during part of which spelter conditions were very abnormal, and therefore no suggestion is made

that any particular brand mentioned is better or worse than another according to the lesser or greater lead content. In the case in question the spelters are being employed almost exclusively in the manufacture of gunmetal of Admiralty composition (88:10:2), and since no objection is raised to the presence of 0.5% of lead as a maximum in this alloy, the quantity of lead occurring in the spelter is of slight importance.

CONDITIONS NECESSITATING LIMITS BY SPECIFICATION

Under other conditions, however, if, for example, the spelters are to be used for the manufacture of high-grade brasses, it obviously becomes necessary to limit rigidly the proportion of lead by specification and to sample carefully each lot delivered. From the figures given, it is clearly unsafe without checking to depend upon the constancy of a particular brand one or more previous consignments of which may have proved satisfactory as regards lead content and in practice.

H. Kaye (London) wrote that his information is to the effect that practically all the brass trade in the United States today ignores cadmium up to 0.40% in the manufacture of cartridge brass, german silver and similar alloys, this view being based upon the result of practical experience. Chemists and metallurgists of the highest repute, also, are unable to determine with certainty the presence of cadmium in the alloy made with spelter containing up to 0.40% of cadmium, and interest in the investigation as to the effects of small percentages of cadmium in cartridge brass has perceptibly decreased because of the growing conviction that the subject bears no important relation to the superior performance either in brass mill practice or proof-firing tests.

It is quite safe to assume that in America since August, 1914, more cartridge brass has been produced from high-grade spelter containing up to 0.5% cadmium than from cadmium-free high-grade spelter. To the brass manufacturer a minimum content of lead and iron in zinc for cartridge and similar mixtures is of more importance.

The average of 50 assay certificates covering 50 carloads of American high-grade spelter made from virgin ores handled during recent weeks was: Cadmium, 0.22%; iron, 0.011%; lead, 0.00823%.

Season cracking, which was formerly attributed solely to cadmium, is now recognized to be the result of internal strains due to improper heat treatment or the entire lack of heat treatment.

In Great Britain 99.9% spelter is produced by redistillation, and the difference in volatilization enables manufacturers to separate the two metals.

Norwegian producers of high-grade spelter (also by redistillation) expressly ignore cadmium, the general conditions of sale being that 99.9% spelter be guaranteed to contain, in the aggregate, not more than 0.1% of lead and iron (generally the proportions are 0.07% lead and 0.005% iron, the lead and iron contents being analyzed and the zinc contents taken by difference).

Maufacturing experts have held the view for many years that the objection to cadmium up to 0.5% on the part of metallurgists was based on laboratory practice only and not on the use in bulk of cadmium-bearing spelter (up to 0.5%); and since the outbreak of the war, when the manufacture of cartridge brass became a major industry, many of the most respected nonferrous chemists and metallurgists in the United Kingdom have quietly accepted the view that cadmium up to 0.5% is injurious only when spelter is used for sheet rolling, for galvanizing and for making slush (ornamental) castings.

Military engineers have been the last to accept the opinion that cartridge brass made from cadmium-bearing spelter fulfills every necessary test, their revised specification for high-grade spelter permitting a maximum of 0.15% cadmium.

In this connection a report of proof-firing tests on four 3-in. artillery cases, made in the ordinary routine of brass mill practice, with high-grade spelter carrying between 0.30% and 0.40% cadmium (other impurities being 0.009% lead and 0.01% iron) is of interest. It shows that the weight of charge varied from 24.5 to 26 oz., the projectile weight being 18.5 lb. and the mean pressure varying from 14.4 to 15.2 tons per sq.in. In all, 73 rounds were fired, rounds 1 to 24 inclusive in one gun, and rounds 25 to 73 inclusive in another. The report concludes, after giving details of each shot, "These cases are considered to have passed an excellent test in all respects." The cases were fired at the proving grounds of one of the most eminent ordnance firms in America and were passed by British inspectors.

The New Cornelia Leaching Plant

Construction on the 5000-ton leaching plant being built by the New Cornelia Copper Co., at Ajo, Ariz., is being carried on as rapidly as possible. On Feb. 1, the trestle and tail track, as well as the primary crushing plant, are practically complete, and with the exception of some electrical work this part of the plant is finished.

Work on the ore-storage bin, which is between the primary and secondary crushing plants, is going ahead rapidly, while at the secondary, or fine-crushing plant, the elevators are 90% completed. The placing of the stationary screens and the completion of the oiling system will practically finish the work on the fine-crushing end. At the leaching tanks, the steel for the central structure which will contain the pumping system is up. Six pumps and brackets are in place. Work on the Hulett excavator has been started, and the transfer table is about 90% completed. Pipe trenches are complete, and the laying of the lead pipes will be begun immediately.

Steel for the absorption towers has been erected, and excavation for circulation pumps and pipe trenches completed. At the tank house, the piping and the bus bars are about 80% completed. Work on the tank-house cranes is progressing rapidly. In the power house, three motor-generators are in place; No. 2 turbine is about 75% and electrical work about 70% completed. Concrete work on the cooling pond has been finished, and the suction and discharge pipes are being installed. Pipe work in the cooling pond itself is over 90% completed.

Ore is still being shipped from Hill No. 3, to Douglas for reverberatory fettling. The steam shovel working between Hill No. 1 and Hill No. 2 is loading dirt for ballasting the tracks from mine to coarse crusher.

Flue Dust for Making Specular Iron—The Société des Aciéries de Paris et d'Outreau has installed a 500-kw. furnace for dealing with the flue dust from some Cowper stoves working in conjunction with ferromanganese blast furnaces. "Iron and Coal Trades Review," of Dec. 22, 1916, reports that the dust contains about 25 to 30% of manganese and is treated in the form of briquettes in the electric furnace to make rich specular iron.

The Wetherbee Iron-Ore Concentrator at La Rue Mine

By Stanley A. Mahon*

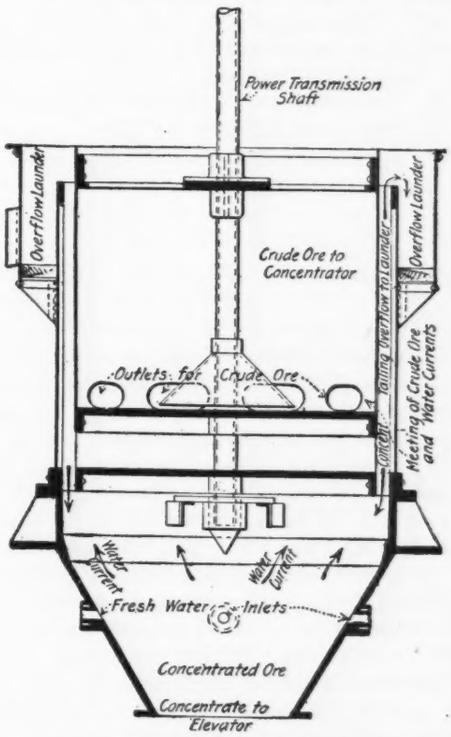
SYNOPSIS—Description of concentrator for use in cleaning and concentrating iron ores, the action of which depends upon the effect of an upward swirling current of water. Gives excellent results on hard coarse ores but on soft ores requiring mechanical agitation which is given by the log washer this concentrator has not been so successful.

The Wetherbee concentrator is designed to simplify the iron-concentration process and do the work now done by turbos and tables. The machine, as shown, consists of a cylindrical drum carried on a vertical shaft within an outer casing. The shaft is driven from above. The drum compartment receives the ore to be washed and discharges it by centrifugal force through openings into the annular space between the drum and casing. The casing has an overflow launder at the top and is bolted at the bottom to a water-tight compartment connected with the boot of an elevator. The required water enters at the base of the machine, rises through the annular space between the revolving drum and the casing, and discharges into the launder at the top of the casing.

The work of the machine is based on the following principle: If, during a second of time, a particle of ore settles 4 in., while a particle of quartz settles only 2 in., it is evident that in order to separate these two particles by means of an upward current of water, a current of somewhere between 2 and 4 in. per sec. would be required, or say 3 in. per sec. Assuming that these same two particles are placed in the Wetherbee concentrator and the revolving drum given such a velocity that the quartz particle remains in suspension, traveling in a given horizontal plane, the heavier ore particle in the same length of time will settle, say 1 in. It is then evident that the slightest upward flow of water will wash out the particle of quartz and still allow the particle of ore to settle, and that the same results are secured by the use of this machine with an upward flow of, say, only $\frac{1}{16}$ in. per sec. as could be secured by upward current alone with a flow of 3 in. per sec., or in other words, with the use of $\frac{1}{48}$ of the amount of water. The fact that the whirling current can be controlled independently of the velocity of the upward rising current allows an exact and independent control over the material that goes into the overflow or into the concentrates, by changing either the speed of the drum or the amount of water used.

The first Wetherbee concentrator, invented by H. E. Wetherbee, of Cleveland, Ohio, was used at the Madrid mine, Virginia, Minn., during the season of 1913. This was a 3-ft. machine and handled the undersize of a revolving screen having ½-in. openings in the screen jacket. The ore was screened without wash water and was fed dry into the machine. This is the ideal manner of feeding, as the entire flow in the sorting column can thus be supplied by hydraulic water and the same sorting effect maintained both below and above the feed openings in the cylinder; but on heavy feeds of lean ore, dry feeding is quite impracticable.

During the same season a 6-ft. machine built by the National Iron Co., of Duluth, for the La Rue Mining Co., was installed in an experimental plant at the La Rue mine, Nashwauk, Minn.[1] Much experimenting was done during this and the following season, and in 1915 the machine was made part of the permanent installation, handling the tailings of the coarse log washer, work done theretofore in the district by the turbo log washers. After experimenting with a small machine, a 3-ft. machine was built and installed to handle the tails of the 6-ft. machine, doing the work of eight concentrating tables. The dimensions of this machine are not yet



WETHERBEE CONCENTRATOR

standardized; the correct height of the sorting column not being fully determined, but it has given quite satisfactory results.

The Wetherbee concentrator is not a centrifugal machine in its action as a classifier. Centrifugal force does move the pulp from its point of entrance into the cylinder to the parts where it enters the sorting column. From its point of entrance to the sorting column it is subject to the action of a hindred settling classifier, the whirling motion of the water only serving to lessen the settling velocity, and hence to diminish the amount of hydraulic water necessary to maintain the sorting action.

Different speeds of rotation between 18 and 40 r.p.m. have been tried, but it is found that the best results

*La Rue Mining Co., Nashwauk, Minn.

[1] "Nashwauk Iron-Washing Plants," by L. A. Rossman, "Eng. and Min. Journ.," Sept. 16, 1916.

are obtained with a speed of 28 r.p.m. for the 6-ft. machine and 36 r.p.m. for the 3-ft. machine, the only adjustments for varying grades of ore being in the amount of hydraulic water used. The amount varies between 80 and 150 gal. per min., depending on the grades of the ore. The thickness of the pulp seems to make no difference up to the heaviest feed yet tried, while the volume is kept constant. The millman in charge watches the product and increases or restricts the flow of hydraulic water in the same manner as a jigman raises or lowers the gates of a jig.

The maximum capacity of either size machine has not been determined, the maximum capacity of the elevators having been reached in both cases before the classifier became overloaded. The 6-ft. machine has been found to work well on feeds of 50 tons per hr. On ores in which the ratio of concentration is lower, or in which the difference between the specific gravities of ore and gangue is greater than in the case of hematite and silica, larger feeds could be handled.

The following data on speeds and amount of water used in daily mill runs are for ores of different grades and structure and hence are of use only as examples of the work done by the machine:

TABLE 1. SPEED AND WATER USED IN CONCENTRATION

Speed, R.P.M.	Water Gal. per Min.	Feed, Tons per Hr.	Feed, % Fe	Concentrates % Fe
36	80	30	53.48	56.98
34	90	30	53.74	60.12
32	100	35	50.98	62.04
32	100	35	44.21	61.34
30	90	30	38.84	57.41
28	100	36	47.21	60.58
28	120	40	37.55	57.93

The power required to operate the machine itself is almost negligible. The lower half of the revolving cylinder forms an air chamber the buoyant effect of which nearly floats the cylinder which is hung on a ball-bearing journal at the top. The friction of the loose pulley on the countershaft is sufficient to keep the machine rotating at full speed when the belt is shifted from the tight to the loose pulley. In treating iron ore in which the ratio of concentrate to feed is high, the chief item of power is in the operating of dewatering devices to remove the ore from the hutch, which at the La Rue is done by means of a rope-and-bucket elevator using between 8 and 10 hp. If used on other ores where the ratio of concentration is low—for example, native copper rock—this could be done by plug discharges.

The Wetherbee machine has been tried out on coarse ore, such as is in this district treated in log washers, but on soft ores and those containing paint rock and requiring mechanical agitation supplied by the log washer, it has not proved successful. The log washer is manifestly the machine for this work, being of large capacity and delivering a dewatered product, and its details and dimensions have been worked out so that the ore receives sufficient scrubbing and disintegrating action for the machine to deliver a clean product. The turbo log washers are used for the same work that the 6-ft. Wetherbee concentrator is doing and are proving successful. The logs are kept submerged in water, and hutch water is supplied beneath the logs so the ore receives a mechanical agitation and forward movement beneath the water and also receives a sorting action from the hutch water. The 6-ft. Wetherbee has, however, a much greater capacity than the standard 18-ft. turbo.

No comparative tests have yet been run between the Wetherbee and the turbos on the same ore, but this will be done during the season of 1917. The following results were obtained from runs made on the same date by a mill using the screen log washer, turbo and table system, and the La Rue mill using screens, log washer and Wetherbee system, both mills running on ore loaded by the same steam shovel, loading a train for first one mill and then the other. The figures show the results obtained by the entire mill systems and not the individual work of either machine, excepting in the analyses of their product.

TABLE 2. RESULTS OBTAINED WITH AND WITHOUT WETHERBEE CONCENTRATORS

	Feed, Fe	Conc., Fe	Tails, Fe	Percentage of Recovery in Weight	Percentage of Recovery in Iron Units
Screen, log, turbo and tables	43.03	59.90	25.31	50.93	70.90
Screen, logs and Wetherbee	41.87	57.56	24.24	52.90	72.73

These runs were made on a low-grade ore in which the impurity is a rather coarse sand instead of the finer sands found in the ideal wash ores, and the loss in weight and iron units is unavoidably high.

TABLE 3. WASHING DATA AT TWO WESTERN MESABI MILLS

	Dry Iron	Natural Iron	P.	Mn.	SiO_2	Moisture	Percentage Recovery by Weight	Percentage Recovery in Iron Units
Mill Using Screen, Log Washer, Turbo and Tables								
Crude ore	46.87	42.25	0.039	....	27.17	9.86	62.70	78.60
Concentrates	58.78	54.02	0.043	....	10.24	8.09		
Mill Using Screen, Log Washer and Wetherbee								
Crude ore	50.66	.....	0.037	0.39	21.70	....	68.94	81.39
Concentrates	59.81	53.22	0.043	0.57	8.77	11.06		

A comparison of the averages of the 1916 operations of two mills on the Western Mesabi Iron Range gave results as shown in Table 3. One mill used the screen, log washer, turbo and tables, and the other used the screen, log washer and Wetherbee.

Lithographic Stone

In 1916, for the first time, there was a considerable production of lithographic stone in this country. This production, according to G. F. Loughlin, of the United States Geological Survey, was made by the Kentucky Lithograph Stone Co., which has quarries at Brandenburg, Ky. In 1916 the company sold 40,000 lb. of finished stone at prices ranging from 2½ to 27c. per lb. For some years previous, small quantities had been sold occasionally in Louisville, but in 1916 the stone was shipped to buyers as far away as Cleveland, Washington, New York and Boston.

The quarry at Brandenburg contains three distinct beds from which lithographic stone may be obtained. Two of these beds are about 3 ft. thick and one 9 to 10 ft. thick. They are separated by beds of limestone of other varieties and make up only about 20% of the stone that must be removed. The remaining 80%, however, is available for other uses, and considerable quantities were marketed in 1916.

Specifications for Reinforced-Concrete Design have been issued by the Portland Cement Association, Chicago. They are based on the regulations in the building code recommended by the National Board of Fire Underwriters. Specifications for proper distribution of live and dead loads, material requirements and permissible stresses are given. In the design of slabs, beams and girders, permissible factors are given for bending-moment calculations and design. The requirements of columns and walls also receive consideration. Copies of the specifications can be obtained from the Portland Cement Association, 111 West Washington St., Chicago, Ill.

Flin-Flon Lake Copper District

By John W. Callinan*

SYNOPSIS—Two copper mines of the first magnitude have been indicated by drilling during the first year's development of this interesting mining area around Flin-Flon and Schist Lakes at the Manitoba-Saskatchewan boundary, about 650 mi. northwest of Winnipeg and 90 mi. from the railroad at Pas, Manitoba. Tonopah Mining Co., interested in rich chalcopyrite orebody, while large low-grade deposit is being drilled by Messrs. Hayden, Stone, Jackling, Clark and Coolidge.

The Flin-Flon Lake mining district, which lies about 650 mi. northwest of Winnipeg and about 90 mi. northwest of Pas, Manitoba, is situated on the boundary line between Saskatchewan and Manitoba and is reached in winter by a sleigh road 90 mi. long and in summer by boat and canoe, a distance of 200 mi.

The history of this camp is extremely interesting owing to the fact that during its first year of life over $45,000,000 worth of ore has been indicated on two properties by diamond drilling. The Great Sulphide at Flin-Flon Lake—or, as it is better known, the Hammill property—has 3,000,000 tons of $10 ore blocked out above the 250-ft. level. The Mandy Mining Co. has

CAMP AT FLIN-FLON LAKE, MANITOBA
Thomas Creighton, discoverer of Flin-Flon district, in doorway

110,000 tons of copper ore said to average 22% to 28% copper, $3.60 in gold and 9 to 16 oz. in silver.

There has never been a boom in the Flin-Flon Lake district, owing to the fact that John E. Hammill and his associates were content to develop their property themselves. F. C. Jackson, who staked the Mandy claim, had met J. E. Spurr, of the Tonopah Mining Co. of Nevada, on his way into the district, and showed Mr. Spurr a specimen of the ore he had found. Mr. Spurr immediately recognized the value of the find and took over the property on behalf of the Tonopah Mining Co., agreeing to develop it, Mr. Jackson to retain a 15% interest.

*Office of the Commissioner of Northern Manitoba, Pas, Manitoba, Canada.

It has therefore not been necessary for the owners of these claims to go to the public for assistance to develop their properties, and consequently little is known about this camp except by those intimately connected with its development. Another factor, which has perhaps been the reason of no further finds of note, is the lack of prospectors owing to the present war. Development has gone ahead steadily at the two properties mentioned, and great things are looked forward to in the next few years.

To make this camp a success a railroad must be built, which will be about 90 mi. in length from Pas, as it would be impossible to carry on development on the scale necessary without the proper transportation facilities. It is the intention, however, of the Hammill syndicate to develop the orebody further by diamond drilling so as to determine the desired capacity of the smeltery. A net profit of about $4 per ton is estimated for this ore.

During the summer of 1916 the Dominion government sent hydro-electrical engineers up to the Churchill River 80 mi. north of Flin-Flon to ascertain the amount of water power available. They reported that 50,000 hp. could be developed—an ample supply for all purposes.

The ore at Flin-Flon is a sulphide and occurs in a solid mass; it does not as a rule contain any quartz. The principal metals are gold, silver, copper and zinc. The formation in which these orebodies occur is of ancient volcanic rocks, greenstones, pyroclastics and autoclastics together with conglomerates and intrusions of quartz porphyry. The orebody at Flin-Flon Lake strikes 40° west of north. The first discovery at Flin-Flon Lake was made in August, 1915, by Thomas Creighton, prospector for the Hammill, Currie & Fasken syndicate, of Toronto, Ont. The first discovery was on the southeast shore of Flin-Flon Lake, where a large outcrop of oxidized ore occurs. Ten claims were then staked, and they comprise the present Great Sulphide Co.'s property. After the claims were staked and recorded, some trenches were run disclosing in places ore over 200 ft. in width. This was sampled, but owing to surface concentration the metallic content was extremely high; resampling, after shooting off the top of the orebody, disclosed the fact that the ore would average about $10 per ton in gold, copper and silver, the copper content averaging 1¼%. The orebody has been trenched for 1700 ft. at different points and it is thought that it will be over 2000 ft. long. It is narrowest at the north end and widest at the south end where it enters the lake. Here it is nearly 300 ft. wide—solid sulphides. The orebody is broken up in some parts of the vein, but it is mainly a solid mass.

In the fall of 1915 R. B. Watson, of the Nipissing Mining Co., sampled the property where it had been trenched by the prospectors. The proposition was, however, too large for his company, so was dropped and nothing

further done as the terms called for $2,000,000 for 31% interest in the property, the erection of a smeltery and the development of water power and building the railroad. In February, 1916, Mr. Hammill succeeded in interesting Messrs. Hayden, Stone and Jackling, of New York, and Clark and Coolidge, of Boston. They agreed to spend $50,000 in diamond drilling and sampling the property. The Clark and Coolidge interests were looked after by Mack H. Newman and C. P. Woods, of Mascot, Tenn., and Orrin P. Peterson. Hayden, Stone and Jackling's interests were looked after by Raymond A. Brooks, who came from the Ray mine, Ray, Ariz.

Diamond drilling was begun with two drills on Mar. 26, 1916, and continued until July 15, during which time over 18 holes were put down and over 6000 ft. of drilling done. This drilling proved up over 3,000,000 tons of $10 ore and does not allow for any ore below the angle of drill holes nor for any probable ore. The drilling did not extend over 1200 ft. on the orebody. By those familiar with deposits of this kind, it is estimated that with proper drilling at least 30,000,000 tons of ore can be proven up in two years' drilling. The initial outlay, before production can begin, is estimated to exceed $12,000,000.

The Rich Mandy Claim Located by Civil Engineer on His First Prospecting Expedition

The other discovery of importance is the one made on the Mandy claim, staked by Fred C. Jackson, a civil engineer on the Hudson Bay Ry. Mr. Jackson had never been on a prospecting expedition until October, 1915, when he staked the present Mandy claim. Here was found an outcrop of chalcopyrite over 35 ft. wide on a small point or arm extending into Schist Lake. This property lies about 3 mi. southeast of Flin-Flon Lake.

In March, 1916, the Tonopah Mining Co. began operations and uncovered the vein, which showed on the surface a shoot of ore from 15 to 40 ft. wide of solid chalcopyrite averaging from 22% to 28% copper, $3.60 gold and 9 to 16 oz. in silver. Diamond drilling was begun in April, 1916, and about 4000 ft. of drilling was done. This disclosed 110,000 tons of ore averaging over 22% copper, or at 30c. a pound over $14,520,000 without counting the gold or silver. For each thousand dollars spent drilling in this camp, over $1,250,000 in ore has been disclosed. At present the Tonopah company is working about 40 men getting out ore, which is being hauled by sleigh to Sturgeon Lake, a distance of 40 mi. From there it will be taken by barge 160 mi.—during the summer—to Pas and shipped to British Columbia for treatment. There are 150 teams hauling ore and supplies at present, and the daily output is 50 tons. It is the intention of the company to get out at least 3500 tons and as much more as possible. Henry C. Carlisle is engineer in charge of the work. The company is called the Mandy Mining Co. and is a subsidiary of the Tonopah Mining Co. A complete plant of machinery will be installed as rapidly as delivery is made, and a shaft will be sunk and actual underground development work will be carried on.

The data concerning the Great Sulphide property were obtained from John E. Hammill and for the Mandy mine from F. C. Jackson. During the summer of 1916 Professors Wallace[1] and DeLury, of the University of Manitoba, paid the Flin-Flon district a visit, but owing to the work carried on being under option, no specific data in regard to mine developments were given out. They examined the surface carefully and were very favorably impressed.

The laws governing this district are the Dominion mining laws, and there are no apex rights, all claims having vertical side and end lines. The province of Manitoba has appointed a commissioner for the northern district of the province, and it is the intention to aid the mining industry in every possible way. The Commissioner for Northern Manitoba is John A. Campbell, of Pas, Manitoba. The provincial government is building a wagon road a distance of 18 mi. from Sturgeon Landing to Lake Athapapuskow. It is over this road that the Mandy ore is being hauled.

[1]"Mining Developments in Manitoba," by R. B. Wallace, "Eng. and Min. Journ.," Jan. 6, 1917, p. 80.

Foreign Trade in Lead and Zinc

Imports of lead and zinc in December, 1916, are reported by the Department of Commerce as follows:

Articles and Countries	Contents, Lb.
Lead Ore:	
Canada	30,000
Mexico	1,261,315
Peru	31,545
Chile	22,865
	1,345,725
Lead in Base Bullion and Bullion:	
Canada	5,664,475
Mexico	891,312
Peru	6,532
	6,562,319
Lead, Pigs, Bars and Old:	
England	16,016
Mexico	100
Costa Rica	44
Panama	1,581
Barbados	1,050
Chile	2,898
	21,689

The actual tonnage of lead ore imported in December was 2812. The imports of zinc ore amounted to 28,467 tons in December. The countries of origin and the metal contents of tonnages imported were as follows:

Countries:	Contents, Lb.
Spain	5,080,588
Canada	1,401,200
Guatemala	10,080
Mexico	8,416,615
Australia	11,397,684
	26,306,167

Zinc in blocks, pigs, etc., was imported as follows (in pounds):

Canada	127,265
Panama	2,282
Cuba	19,109
Haiti	265
Chile	3,684
	152,605

Imports of zinc dust were as follows (in pounds):

Japan	89,864
Australia	1,398
	91,262

Exports of lead and zinc were as follows (in pounds):

Lead, Pig, Bars, etc.:	
Produced from domestic ore	11,732,729
Produced from foreign ore	1,841,845
Zinc, Pigs, Bars, etc.:	
Produced from domestic ore	28,458,198
Produced from foreign ore	5,915,943
Zinc, plates and sheets	2,845,358

Vanadium Steel Parts amounting to 447 lb. go into the make-up of one of the standard types of automobiles and comprise shafts, pinions, gears, springs, connecting-rods, crankshafts, etc.

Dry Concentration of Gold Ore

By Leonard Goodday*

SYNOPSIS—The record of the installation of a mill requiring of its designer the superintending of a part of the machinery construction at the factory. The novel feature is a dry concentrating machine that had formerly been successfully used at a plant in North Wales. The installation was made and put into successful operation.

At a mine near Bala Lake, West Australia opened in 1863, and said to have produced a great deal of ore up to 1865, from which 1500 oz. of gold had been recovered by concentration, the metallurgical problem to be solved by a new company was the economical recovery of gold from low-grade ore. The original mill at this property contained old Cornish stamps and Berdan pans as crushing machinery.

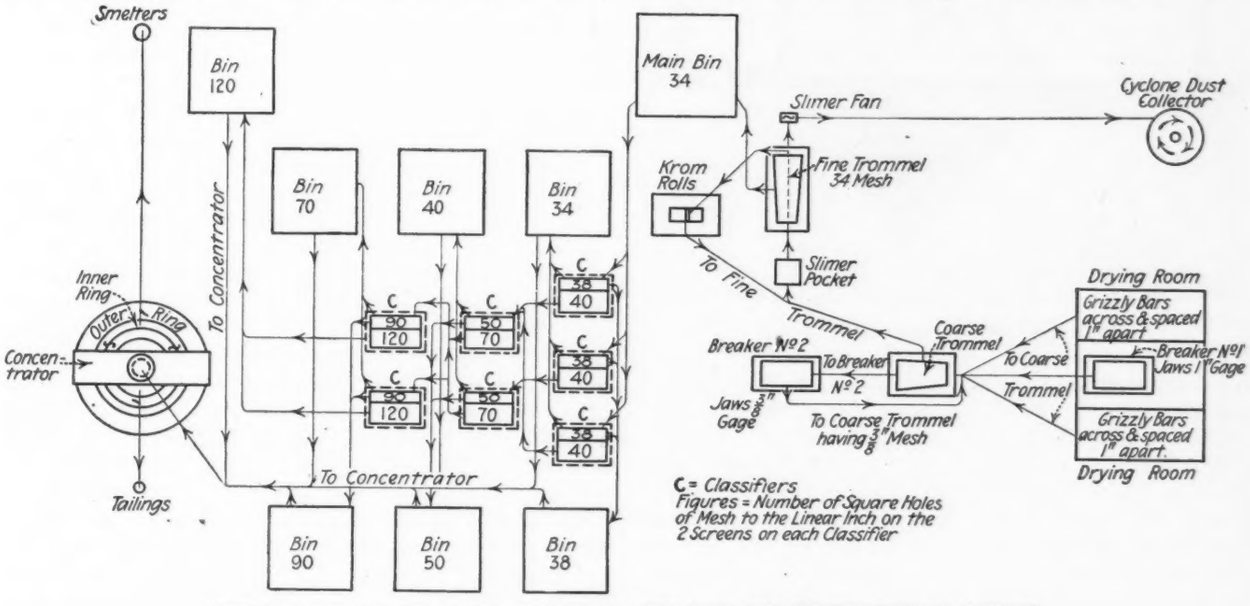
The operation paid tolerably well while the oxidized ores were being treated, but when sulphides of zinc and lead were met, monthly returns soon failed to pay wages and like many others, this mine was abandoned. It was reopened by private enterprise and for four years, steady development work proceeded. When the nature of the ore had been well studied and many thousands of tons developed, the owners looked for a plant which was most likely to treat successfully the low-grade sulphide gold ore. A dry concentrator, invented in 1889 by Clarkson and Stanfield, was used at the Carn Dochan mine, and was suggested for use here.

The mill, as finally constructed, consists of three floors, and is built in a substantial manner. Elevators and conveyors are utilized, so that the ore is never handled from the time it is fed into the first rock breaker until concentrates are sacked. A Jonval turbine working under a head of 65 ft. develops about 60 hp.

*Mechanical and civil engineer, 309 Gladstone Ave., Ottawa, Ont., late of the British Admiralty.

The ore is brought from the mine by a tramway and delivered to the drying chambers on the top floor of the mill. The floors of these chambers, which are practically air-tight,, consist of iron bars placed about 1 in. apart. The ore is dumped on to these grids to the thickness of about a foot. A partition divides these rooms, about the middle of which chutes lead to the first rock breaker so that the ore can be fed from the rooms alternately. Outside the mill, opposite the dividing partition, a Blackman fan is fixed so that by shutting off one chamber, a strong current of dry air is drawn through the body of the ore deposited in the other, and vice versa.

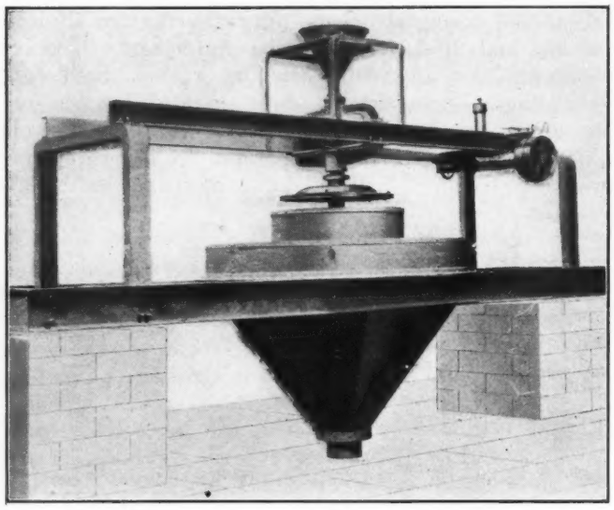
The heated air produced by a fire on the ground floor of the mill is conducted through pipes to the under side of the drying chambers, drawn by the fan through the ore, and discharged into the atmosphere. The ore is quickly and effectually dried at a very small cost. From the dry chambers the ore is shoveled into the feed hopper of No. 1 rockbreaker, of the Blake type, from which it passes considerably reduced in size through a revolving trommel with ⅜-in. punched holes. This trommel delivers the rough portions of the ore to No. 2 rockbreaker, where it is further reduced in size, and thence it passes by gravity to a Dodge-type crusher, which gives a product of about ¼ in. From the Dodge crusher the ore is elevated to the first trommel so that, up to this point, everything is crushed to pass a ⅜-in. hole. The ore is now elevated to the top of the mill by No. 2 elevator into a double trommel, the inside plate having perforations of $\frac{1}{16}$ in. and the outside covering being a 30-mesh wire screen. The ore which passes 30-mesh is sufficiently reduced for the sizing and concentrating, which forms the second part of the installation. The ore between 10 and 30 mesh falls down a chute to the feed hopper of a set of high-speed Krom rolls, by which it is reduced to such a degree that it



FLOW SHEET OF THE MILL, SHOWING THE DRY-CONCENTRATING MACHINE

will pass the 30-mesh screen in the trommel, being continuously conveyed there by the No. 2 elevator, the boot of which is in connection with the delivery spout fixed beneath the rolls. The whole of the ore thus being reduced to pass a 30-mesh screen goes to the slimer, which extracts the fine, unpalpable powder and collects it in a cyclone dust chamber. This slime in the Carn Dochan ore is nearly barren of mineral, but in cases where the gold is very fine the contents of this dust chamber are rich concentrates.

After passing the slimer, the ore is graded into the following sizes: 30 to 35, 35 to 42, 42 to 50, 50 to 70, 70 to 90, 90 to 120 and under 120. Two systems are in use for this classification. First, ordinary reels are used by millers, and second, flat vibrating screens operated by a triangular cam. The latter form is efficient and so simple in construction that it can be made at any mill. The sized ore then passes into bins capable of



DRY-CONCENTRATING MACHINE

holding many tons. From the bottom of these bins a spout leads to the boot of elevator No. 3, which conveys any grade to the hopper of the concentrator.

The action of the concentrator or distributor is based upon the joint operation of the three powers, centrifugal force, atmospheric resistance and gravitation. Pulverized ore is fed on to the center of the rapidly rotating disk grooved with a number of radial channels, and on it there fits a solid cover. The ore passes along the channels, and is ejected at the circumference with a uniform velocity. The particles of rich and heavy ore, by reason of their superior inertia, are thrown to a greater distance, while the worthless particles, being higher, are more quickly overpowered by the force of the atmospheric resistance and gravitation and thus fall short, being separated effectively.

The collection of the ejected ore in annular receivers at various distances, is thus easily accomplished and in fact, goes on continuously, while the ore is being shot out. Means are also provided for regulating either the centrifugal force or the atmospheric resistance, according to the nature of the ore. There is nothing in this machine resembling the shaking and blowing method by which dry concentration has hitherto been attempted.

The ore worked was very low in grade, containing about 3 to 4 dwt. gold and 6 to 7 dwt. silver. The first concentrates, from numerous assays, contained 30 to 40 oz. silver and 30 to 35% lead. The second concentrates ran about 20 oz. of gold and silver bullion and the intermediates assay about 8 dwt. gold and silver. The latter are retreated, the heavy sizes by passing again to the rolls to be further reduced, and the fine sizes by passing again through the distributor. These three products contain about 10% of the quantity crushed, and the 90% tailings in most instances are barren. The tailings thrown on the inner compartment of the receivers fall by gravity down an inverted cone, and by means of a creeper are conveyed to the dump, the arrangements being so complete that all handling is dispensed with. The bins placed at different stages of reduction, classification and concentration give great elasticity to the system, and neutralize the effect of one set of machines gaining on the other. Any heavy gold in the ore which, being slightly flattened by the rolls, prevents it passing the 30-mesh screen, is recovered periodically by stopping the crushers for a few minutes and emptying the feed hopper to the rolls.

Estimation of Metallurgical Results

From a close estimate made of the loss, and this can be easily done in the dry process, as everything is to be accounted for, the machine is recovering between 75 and 80% of the actual value of ore. The product is sold to the Swansea smelters, who give a full market price for the gold, silver and lead, the latter two being byproducts and not recoverable by the ordinary method.

The mill is kept comparatively free from dust by the cyclone dust-chamber drawing it away at an early stage by means of a fan which sucks away other particles made by the crushers. The plant is treating a ton an hour and only four men are required to attend to it—one to feed into the rockbreaker, one to watch the screening, one to attend to the concentrator and the fourth to lubricate machinery and watch the fire. The first could double the work and the last three could attend to three or four times as much machinery. When a double shift is being worked for 16 hours a day, which is now contemplated, mining, milling and concentrating will be performed for about $1.25 to $1.50 per ton.

The dotted circle shown in the plan of the concentrator represents a cylinder (below the rotating distributing disk) through which air is drawn by a fan at a certain speed, and which draws any useless dust down from the annular spaces and allows it to drop down the inverted cone with the tailings.

The speeds, shown in the accompanying table, were, on an average, given to the different machines:

SPEEDS OF MILLING MACHINERY

Blackman's fan connected to the drying rooms, about	320 r.p.m.
Blake's stone crushers, one and two	250 to 350 r.p.m.
C. Trommel	25 r.p.m.
F. Trommel	20 r.p.m.
Krom rolls	100 to 125 r.p.m.
Slimer fan to cyclone dust collector, about	1,200 r.p.m.
Classifiers beats, per min., about	900 to 1,000 r.p.m.
Concentrator fan for tailings dust	100 to 120 r.p.m.
Elevator buckets travel	157 to 212 in. per min.
Conveyors about	36 in. per min.
Concentrator distributor, from 130 to 280 r.p.m., according to sizes discharged.	

While the method adopted in treating these ores is somewhat unusual, and the dry-concentrating machine an innovation, the results as shown in this description, justify the means employed for obtaining them.

Correspondence and Discussion

Tempering Rock Drills

The problem of tempering rock drills has given me a great deal of trouble recently. I have tried various degrees of hardness, but can get no satisfactory results. When the drills are hardened sufficiently to stand the work, they become brittle and break easily. Any formula or heat process that can be recommended, I shall be very thankful for. RALPH F. DERBY.

37 Rowell Ave., Beverly, Mass.

The Cottrell Process

In the *Journal* of Feb. 5, 1916, page 252, in an article by E. E. Free on "Colloids and Collodial Slimes," it is said: "It forms the basis of the well-known Cottrell process for the collection of acid and smelter fume, the removal of dust from stack gases, the separation of oil globules from condenser water and the like."

I am at present interested in the removal and collection of oil from water after it has formed an emulsion. This I believe can be done by passing an electric current through the emulsion. Can you give me any information on this matter? Is the Cottrell process applicable to such a thing? Are there any publications on the subject? If so, where are they obtainable? CORNUBIA.

Seoul, Chosen, Dec. 26, 1916.

"Wildcats"

The writer of the interesting communication entitled "Wildcats" in the *Journal* of Jan. 20, must be a confirmed optimist to consider taking up any educational campaign on any such extensive lines as he mentions. In my humble opinion saving the public from themselves is a thankless task when saving one's friends from poor investments is so rarely appreciated.

During the Goldfield boom a friend of mine in Boston wired me to examine some claims which had been represented to him as on a direct line through the Mohawk mine and in such attractive terms that he had purchased them without examination for fear that he might overlook a grand opportunity. The claims were on a direct line drawn through the Mohawk, as represented, but on that line prolonged about 5 mi. out into Stonewall Basin, and the claims netted nothing except three pretty pieces of sardonyx, which I had made into stickpins. Obsessed by the Goldfield boom, the Easterner insisted upon spending some money on these claims and took an option on another group, as far away from the Mohawk in an opposite direction. These, however, he had examined before he paid any money. There was not a chance in the world of finding a mine on them, and I reported adversely. This was received with very bad grace, and my client wired me the price at which he had optioned the claims and asked if, considering the remarkably low figure, I did not think the claims should be taken up. The claims were finally relinquished and the option dropped, but I always felt that my client thought that he had been prevented from getting in on a good thing, until, several years later, he happened to visit Goldfield at a time when I was there, and we visited the scene of his first investment. That trip completed his education in "wildcats."

Life is too short to give intensive courses like this to everybody who has money to spend in mining property. As a matter of fact, they don't want to be educated.

New York, Feb. 3, 1917. M. R. PERCY.

Wage and Bonus versus Wage

In the "Symposium on the High Cost of Mining and Smelting" in the *Journal* of Feb. 3, 1917, it is suggested that sliding-scale compensation dependent on metal price should be consummated by means of a constant base-wage plus the variable bonus payment—accomplished by two wage checks. One of the advantages cited in this connection is the better realization on the part of the wage earner of the temporary status of the bonus, so that less dissatisfaction will occur at the termination of the bonus, due to decreasing metal prices. This is a more or less similar condition to the payment of dividends to stockholders. Some companies have increased their dividend rate, while others have kept it the same but distributed their excess profits in the form of extra dividends.

One of the large metallurgical companies, which has profited immensely by war orders and has augmented its organization many fold, has adopted this system of compensation to its employees. One pay check is given, but it is the sum of two amounts (the base and the bonus), which is indicated on the check. To be sure, the wage scale including the bonus is about the same as the straightway scale in effect in neighboring plants, but the moral effect on the workers on payday is noticeable. They have a distinct feeling of exultation at having obtained some money for no extra work, and the extra bonus is considered in its proper light; that is, a separate windfall due to unusual conditions. Being a windfall, it is treated according to the individual inclination of the receiver, but is considered distinct from the main amount, which is compensation for labor performed.

I think that this method of differentiation in the copper camps would go a long way toward reducing discontent dependent upon the stepping-down process, which is inevitable at the recession of copper prices. The worker then will be spared the feeling that he is receiving less and less for the same services performed, which could not fail to have an effect on his efficiency. He will realize that he is getting the same compensation for his services, but that he is profiting less at the expense of world peace and normal conditions. The psychological effect of a bonus system is very evident to those who have worked in a bonus camp and also been present at the "gloom party" attendant with the cut in wages in a straight-wage camp. F. W. FREDERICKS.

New York, Feb. 8, 1917.

Details of Practical Mining

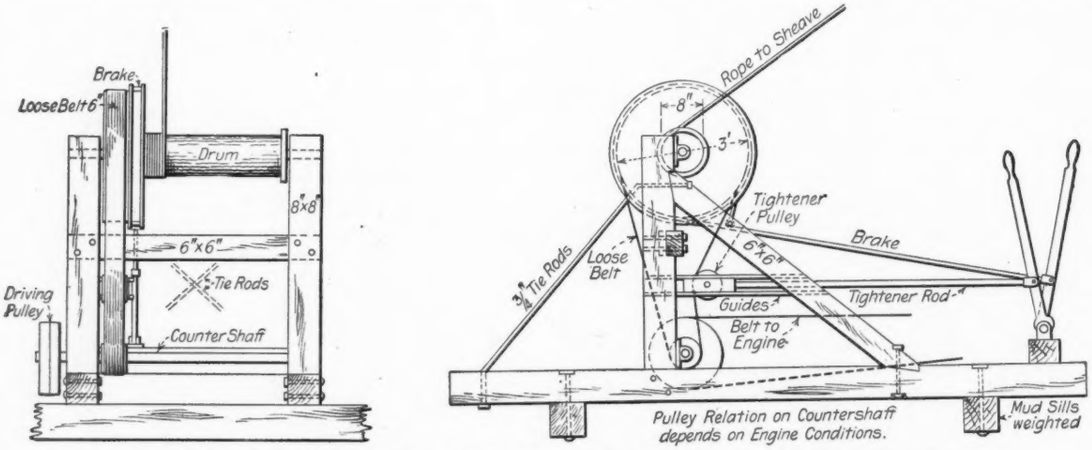
An Economical Prospect Hoist

By L. A. and W. C. Rehfuss*

One of the simplest, cheapest and yet most satisfactory and economical hoists one could want for use in preliminary mine exploration can be rigged up from an ordinary 3 or 5-hp. gasoline engine. It was formerly the custom to employ a horse whim for that period in shaft sinking that occurs before the windlasser really dreams of a mechanical hoist. That was in the days of yore, before precedent and example showed the miner that a gallon or two of gasoline or distillate is cheaper than horse feed.

The equipment shown in the illustration is installed at a small mine at Westpoint, Calif., in what is known as the East Belt of the Mother Lode. The whole contrivance, which is home-made, is operated by a 3-hp. Sampson gasoline engine. It hoists a bucket containing 500 lb. of rock from the bottom of a shaft 110 ft. deep in 1¼ min. Its cost of operation in this land of high freight rates (30 mi. from a railroad) is about 8c. per hr., while running at full capacity, but usually averages the insignificant total of 30c. a day.

A loose belt is employed on the drum, so that when the tightener pulley is released and the brake put on, the bucket can be stopped at any desired place, while the engine continues running, the small pulley on the countershaft turning inside of the loose belt. A third lever, or throttle for the engine, is provided so that the engine may be throttled down while not actually hoisting. It is of great convenience to have all the regulating levers placed near the collar of the shaft, so that the hoistman may handle the bucket and attend to its unloading, where no automatic dumping device is provided. It is essential that a powerful band brake be employed, strong enough to hold a fully loaded bucket at all times so that in case of any belt slips, accidents may be avoided. In the actual operation of this hoist we have not had any slips. By providing an extra pulley on the countershaft, a jackhead pump can be operated in the intervals of idleness of the hoist.

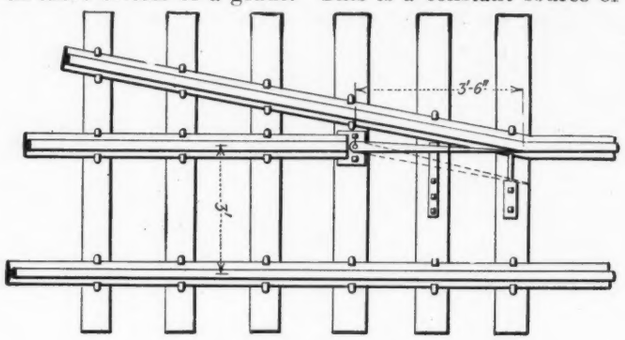


A HOMEMADE BELT-DRIVEN PROSPECT HOIST OPERATED BY GASOLINE ENGINE

*Mining engineers, Deerfoot Mine, Westpoint, Calif.

Simple Derailing Device

It frequently happens that a switch must be put in on more or less of a grade. This is a constant source of danger from runaway cars. The simple derailing device shown in the accompanying illustration, which has been in successful operation for some time at the plant of the Chicago & Big Muddy Coal and Coke Co., obviates this danger, according to Thomas E. Myers, in *Coal Age*.



PLAN OF THE DERAILER

This appliance may be placed just outside the switch so that neither loads nor empties can run far enough to gain dangerous headway before being thrown from the track.

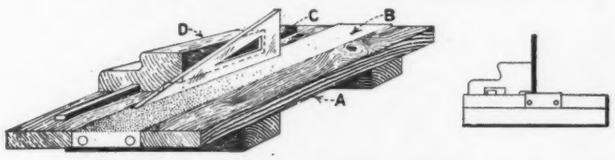
When the latch is closed, it rests against, and is held in place by, a twisted fishplate spiked to a tie near the latch point. It is necessary to lift this latch point in order to open it. This operation must be performed by hand.

*Marion, Ill.

Truing Worn Triangles

If there is a job that most draftsmen hate to tackle, it is truing up the edges of a worn triangle, whether it is of wood or transparent composition.

The rigging shown in the sketch from the *American Machinist* has been devised by P. P. Fenaux to obtain an edge square with the faces and straight for



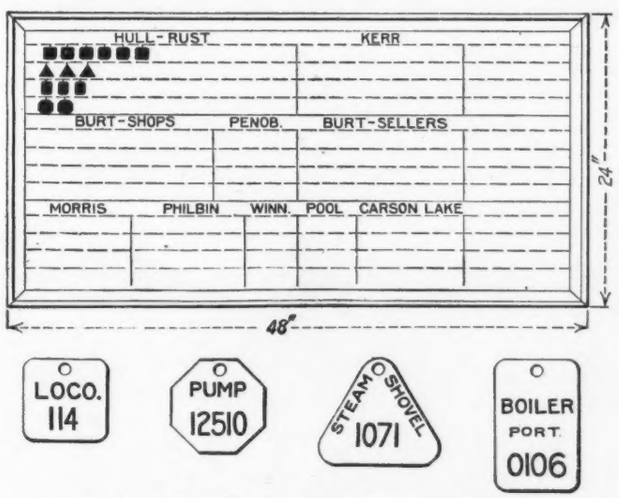
TRUING WORN TRIANGLES

its whole length. On a board *A* approximately 8x8 in., of well-seasoned hardwood, strongly reinforced to prevent warping, are tacked a strip of fine sandpaper *B* and a guiding rod *C*. The hardwood block *D* has its side perfectly square with the bottom and is shaped to fit the hand; the bottom is recessed to allow the triangle to travel over the sandpaper and is grooved with large clearance over the rod *C*. The operation is evident.

Train Dispatcher's Board

By L. D. Davenport*

The accompanying sketch shows a device used by the Oliver Iron Mining Co. at the headquarters shops in Hibbing as a means of recording the location of its movable equipment such as locomotives, steam shovels, etc. For want of a better name the device is called a "Dispatcher's Board." The board is 24x48 in., painted



DISPATCHER'S BOARD AND EQUIPMENT TAGS

black and divided into blocks, one for each mine and one for the shops. Brass wires are stretched across the board and tags hung on the wires. Each tag is numbered to correspond to a certain piece of equipment, and different shaped tags are used for different kinds of machines. The number of locomotives, steam shovels, pumps, etc., at any mine can be determined at a glance. In connection with the board a card-record file is kept which shows the transfers of each piece of equipment, the time it was used at each mine and the repairs while in the shop.

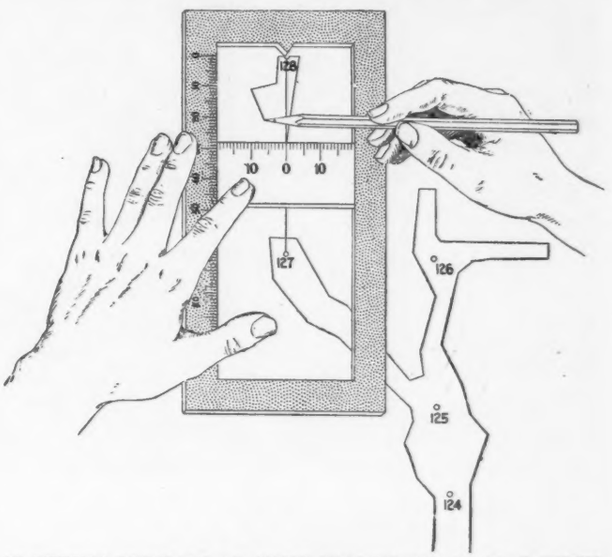
This scheme is a modification of a similar one used by the Oliver Iron Mining Co. at Ely, Minn. to keep track of the machine drills underground. Each stope and working place is represented on the blackboard. Each drill is given two tags, one attached to the drill and the other hung on the board.

*Mining engineer, Hibbing, Minn.

The Zulch Offset Scale

By William G. Zulch*

The device shown in the sketch is intended for the rapid mapping of irregular lines such as mine drifts. The construction of the scale is extremely simple. A frame is made of ¼-in. sheet iron on which a scale is glued or stamped. A movable scale of rectangular form is made from an old celluloid triangle to slide within



PLOTTING IRREGULAR MINE WORKINGS ON MAP WITH THE ZULCH OFFSET SCALE

the iron frame. The course of the main traverse is first plotted (127 to 128 in the sketch), the 0 of the movable scale being over 127 and the distance to 128 being laid of on the fixed scale. The movable scale is then moved up to 0 and the corners of the drift are plotted from the movable scale. The notes for this read 3 ft. to the right and 2 ft. to the left at 128. The movable scale is then moved down to 9 and the note 2.5 ft. right and left is plotted. These points are connected to form the outline of the drift. When any considerable amount of mine mapping is to be done, this scale will prove to be a time saver.

The Proper Time to Remove Forms in concrete work is of a great deal of importance. The following suggestions are given in "The Concrete Dope Book" recently issued by the Cement Tile Machinery Co., of Waterloo, Iowa. Walls and massive work should set one to three days; thin walls, two days in warm weather and five days in cold. Slabs up to 6-ft. span require from six days in summer to two weeks in winter. Beams, girders and long-span work require from 10 days to a month. Columns require from two to four days. In all instances a competent man should be in charge of removing the forms.

*Mine engineer, Vindicator Consolidated Gold Mining Co., Independence, Colo.

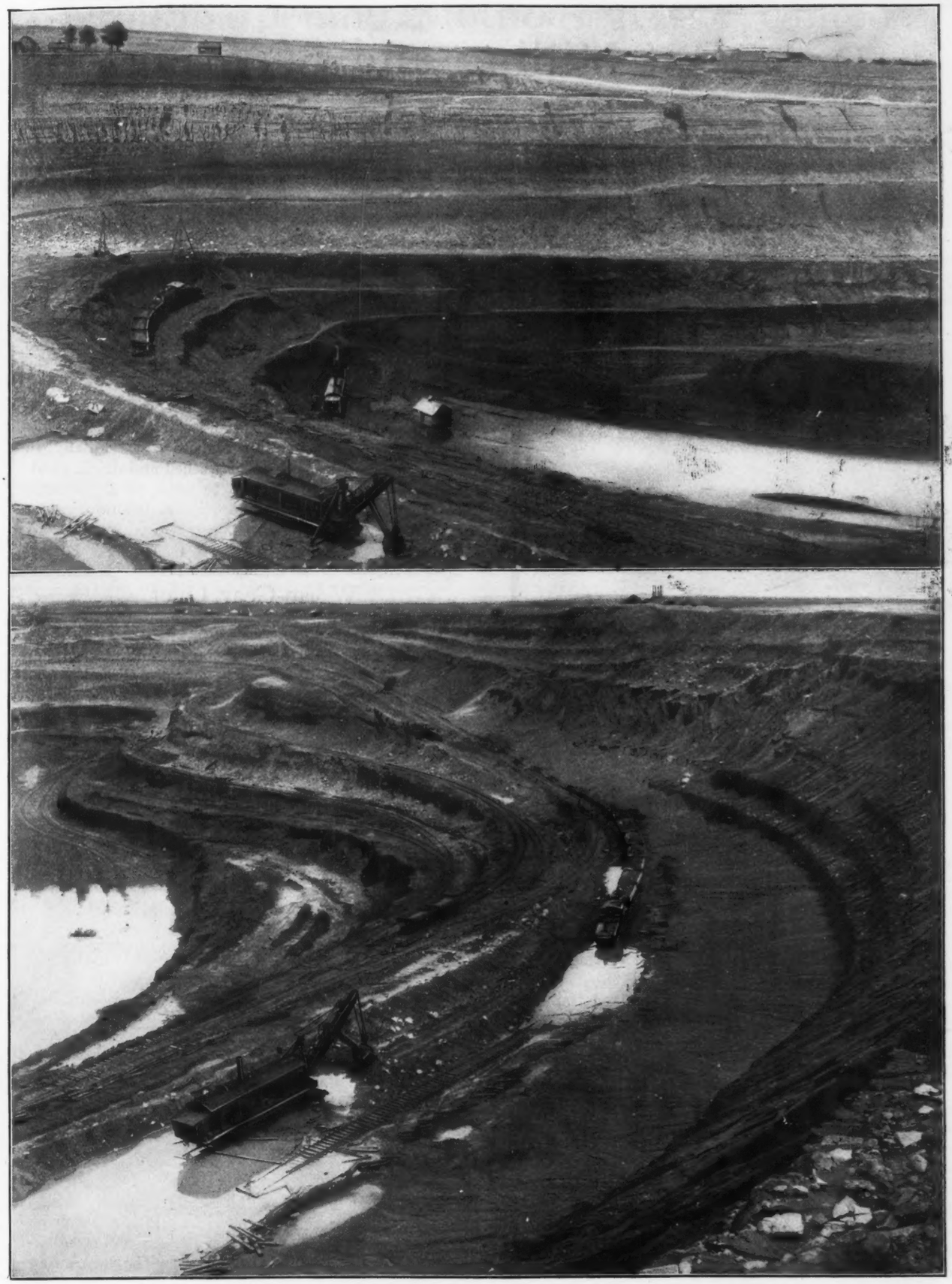
Photographs from the Field

SILVER KING CONSOLIDATED MINE, NEAR PARK CITY, UTAH

This property is west of the old Silver King, extending into Thaynes Cañon. The view was taken looking southwest toward the shaft house, bunk and boarding houses and snowsheds

SILVER KING CONSOLIDATED MILL, NEAR PARK CITY, UTAH

For the treatment of its second-grade ore, the company remodeled the old Grasselli mill, and connected it with the mine by a 2-mi. aërial tramway



EFFECT OF A CLOUDBURST ON A MESABI RANGE OPENPIT MINE

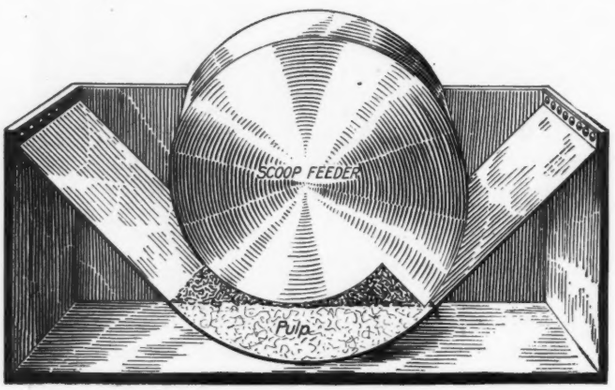
This was one of the deepest pits on the Minnesota iron range. The carefully cleaned ore surfaces around the edges of the pit were covered for a width of over 100 ft. with gravel, boulders and clay scoured out of the banks by the torrents. Tracks were buried and the lower parts of the pit filled with water and mud

Details of Milling and Smelting

Tube-Mill Feed-Box Protector

By A. W. Allen*

Damage at the feed end of a tube mill is often caused when pebbles are "thrown back," or the scoop fails to take the material fed into it. To obviate this, the inside of the feed box should be lined with a strip of steel plate,



PROTECTOR FOR TUBE-MILL FEED BOX

curved in the manner illustrated and placed so that the scoop clears it by half an inch or so. Pebbles, mine rock or other material destined for the interior of the mill will then be taken up by the scoop or pushed aside without doing damage.

Manufacture of Tungsten Powder

The manufacture of tungsten powder at the Widnes plant, England, is briefly summarized by the *Chemical Trade Journal and Chemical Engineer,* Dec. 9, 1916.

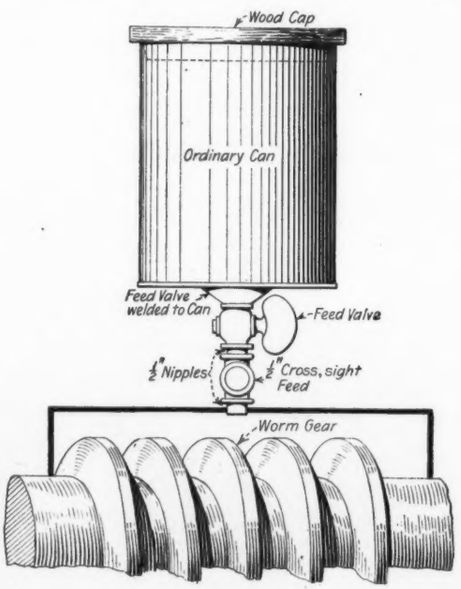
The plant construction was started in November, 1914, and in July, 1915, the plant was completed and put in operation. Except for stoppages due to a shortage of ore supply, it has been in full operation since, giving an output of three tons per day of a purity of 98½%, which incidentally was 1% better than that obtained from Germany previous to the war. The plant occupies a site comprising about six acres, the greater part of which is already covered by buildings. The raw materials consist of wolfram ore, fuel, alkali and acid, and are delivered on a siding, the cars being handled by the company's locomotive crane. The process of manufacture consists essentially in removing the tungsten oxide from the ore, recovering it in a pure state, and then reducing this pure oxide to metal. Six of the eight departments are employed in preparing tungsten oxide, and the remaining two are producing the metal. The first department comprises a warehouse for the storage of ore, the grinding and mixing plant and the magnetic separator. The second department contains furnaces for roasting the mixed ore and soda. The product is broken up in the third department and conveyed automatically into the next department, where it is boiled with water and the tungsten, which has been rendered soluble by the action of the soda, is removed from the other constituents of the ore by filtering. All the tungsten is then collected as tungstate of soda and passes to the next department, where it is treated with acid and the tungsten, now in the form of a yellow oxide, is collected and taken to the next department. Here it is dried and prepared for reduction to metal. The seventh department is a furnace house for heating the crucibles to reduce the tungsten. An extension to this building contains a new continuous gas-heated furnace, which it is expected will replace the present furnaces at a considerably reduced cost. Finally, in the last department the metal is washed and dried, yielding tungsten metal powder, 98 to 99% pure. A large addition has been made to the original laboratories for investigation and research work.

*Metallurgical engineer, 309 Broadway, New York.

Worm-Gear Oiler

By Arthur C. Daman*

For lubricating the worm gears on Dorr thickeners, cup grease is usually employed, but in several mills oil is used instead. The accompanying sketch shows an oil can at-



A WORM-GEAR OILER

tached to the gear case. The novel feature of this contrivance is the ½-in. cross, by which the amount of oil fed can be observed and closely regulated by the valve immediately above it.

*Mining engineer, 2678 Eudora St., Denver, Colo.

Drill-Sharpening Methods at the United Verde, Jerome, Arizona*

By Frank Richards†

The ground in the United Verde mine is hard, and as a result the steel is quite dull when it reaches the sharpening plant. This is especially true of the steel used in conjunction with the Leyner drills. The sharpeners are in continuous operation during the entire 8-hr. period. A highly efficient system of collecting, sorting and routing, sharpening and distributing has been developed at this mine.

DAILY MOVEMENT OF STEELS AT UNITED VERDE MINE

Average number of steels sharpened per day	1,800
Type of bits	Crossbits
Length of steels	2 to 10 ft.
Shanks	60% Leyner-Ingersoll drill shanks with lugs, 20% "Jackhamer" shanks with collar, 20% Stopehamer shanks without collar
Grade of steel	0.75 to 0.95% carbon
Sharpening-plant equipment	Two No. 5 Leyner sharpeners and one No. 3 Leyner sharpener, each equipped with Davies hole-blowing device; three Davies punching machines; three oil furnaces and one tempering furnace
Shop blacksmith force	Three operators sharpening, three helpers heating and punching, one blacksmith tempering, and one utility man
Working shift	One 8-hr. shift per day

Dull steels are collected on the various levels underground, brought to the surface and sorted by nippers onto steel cars. These cars consist of trucks on which are mounted four-section bodies, revolving on ball bearings (Fig. 1). By sorting at this point, the blacksmith is saved several miles of walking each day.

The sharpening plant is located aboveground and has three units, each consisting of an oil furnace, Davies air-operated punching machine, Leyner drill sharpener and Davies blow gun.

The steel travels from the dull-steel car in approximately a straight line through each unit to a car for the sharpened steel (Fig. 3). The sequence of operations is as follows: The helper unloads the dull-steel car and places the steel in the furnace; when it comes to the proper heat, he removes it with his right hand, places it in the punching machine, while at the same time his left hand operates a clamping lever, then moves a few inches to the lever that controls the punch—the entire operation is completed in 2 to 3 sec. The hole in the steel is opened for 3 to 4 in. The helper passes the steel to the blacksmith, who receives it in his left hand, places it in the sharpener, bringing the machine into operation with his right hand. After the bit is formed, the steel is reversed and the shank end is placed against the blower; this movement is really a step in transferring from the sharpener to the car. It is desirable to stand the steel with the bit up.

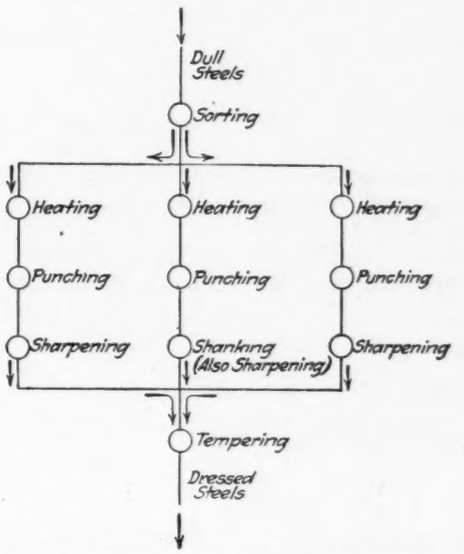


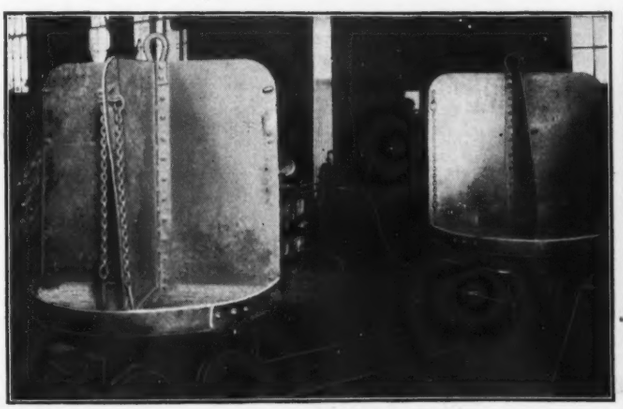
FIG. 3. SEQUENCE OF HANDLING AND SHARPENING OPERATIONS

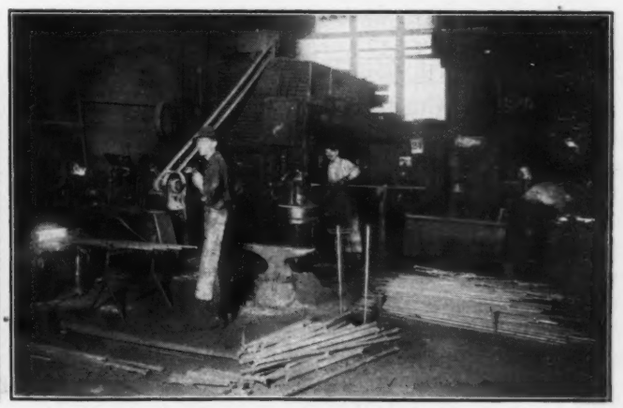
This method is identical for each sharpening unit, the sharp-steel cars from all traveling to one tempering forge. The steels are then brought to a tempering heat and delivered to the slack tub. Plunge tempering is employed, the bits in water and the shanks in oil.

Between the sharpener and the temperer the steel cools to normal temperature and is ready for reheating. The utility man takes care of grinding and dressing the

*Second-prize drill-sharpening article in the "Engineering News" Prize Contest, "Engineering News," Feb. 1, 1917.

†229 West 135th St., New York City.





FIGS. 1 AND 2. DRILL-STEEL CARS, AND A DRILL-SHARPENING UNIT

shanks, the No. 3 sharpener being the only one devoted to shanking. Figs. 2 and 4 show the layout of a sharpening unit. The forge is long and low, heating from 15 to 25 steels at one time. The helper starts the steel in the left-hand side of the forge, gradually working it to the

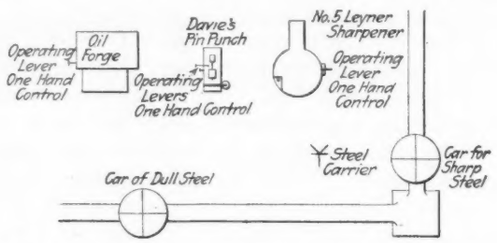


FIG. 4. LAYOUT OF A SHARPENING UNIT

right, each steel thus receiving the proper heat and also bringing it into easy removing position

The punching machine (Fig. 5) consists of an air plunger governed by an oil cylinder. The piston rod carries a chuck for holding the punches. A self-centering clamp operated by an air cylinder insures alignment of steel and punch. This punch has increased the sharpening capacity 50%.

Each steel is tested by a blow gun. The blacksmith, while turning the steel up to place it on the car, pushes

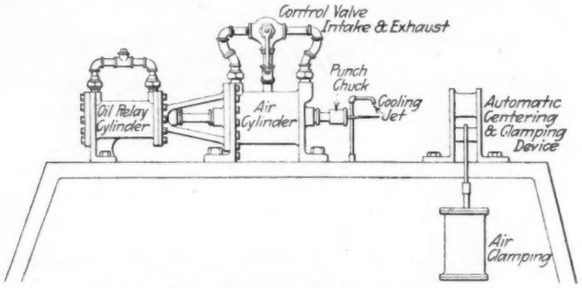


FIG. 5. PUNCH FOR HOLLOW STEELS

the shank against the automatic blow gun. This could be done without reversing the steel, but sparks were sometimes blown upon the operator; and as "Safety First" is one of the mottoes of this shop, the blacksmiths are instructed to test the steel from the shank end. Steel is punched, sharpened and blown out in one heat.

Supervision of drill shanks has resulted in reducing piston and drill-steel breakage. Out of about 5000 pieces used, only two to three are broken per shift.

This paper embodies data furnished by Tom Davies, foreman blacksmith, United Verde Co.

Flotation of Porphyry Copper Ores

The application of flotation to the great porphyry copper mines of the West has been the subject of some calculation on the part of Minerals Separation, Ltd. By the courtesy of that company, the results of these calculations are shown in the accompanying tables, which are self-explanatory. The estimated results of applying flotation to the ores of Utah, Ray, Chino, Nevada Consolidated, Miami and Inspiration mines are shown. By the use of flotation, according to officials of Minerals Separation, a large addition to the amount of copper recovered per ton of ore milled should result, which would make a considerable increase in the ultimate recovery of copper from the total ore reserves of these companies.

TREATMENT SUMMARY OF FIVE PORPHYRIES, SHOWING OPERATING PROFIT-AND-LOSS ACCOUNT. 1915*

Name of Company	Feed Tonnage	Contents Lb. Cu	% Recovery	Present Method: Concentrates Lb. Cu Recovered	Present Method: Tails Loss Lb. Cu Lost	Minerals Separation Process 90% Recovery: Concentrates Additional Lb. Cu Recovered	Minerals Separation Process 90% Recovery: Tailings Lb. Cu Lost	Minerals Separation Process 90% Recovery: Total Concentrates Lb. Cu Recovered	Value per Lb. Copper cts. (credited as per ac.)	Present Method: Copper Concentrates Lb. Cu =	Minerals Separation Process 90% Recovery: Refined Copper Lb. Cu	Value per Lb. Copper cts. (credited as per ac.)	Present Method: Costs per Lb. Cu Cents	Minerals Separation Process 90% Recovery: Profit per Lb. Cu Cents	Operating Profit for Year	Additional Copper Concentrates Lb. Cu =	Additional Refined Copper Lb. Cu	Minerals Separation, Ltd., Process Additional Profit (Cost) per Lb. Cu Estimated at Same Rate as Present Practice)	Total Profit for Year	Estimated Additional Profit for Every Rise of 1c. in Price Cu Additional Profit Will Vary	Estimated Additional Profit by Use of M.S. Processes Costs at 5c. per Lb.
Utah Copper Co.	8,494,300	243,616,524	64.13	156,207,376	87,409,148	63,047,495	24,361,653	219,254,871	17.679	156,207,376	148,397,006	17.679	7.560	10.119	$15,016,293	63,047,495	59,895,120	$56,060,787	$21,077,080	$598,951	$7,594,102
Lb. Cu per ton		28.68		18.39	10.29	7.42	2.87	25.81		18.39	17.47					7.42	7.05				
Ray Consol.	2,848,969	95,326,502	64.11	61,114,514	34,211,988	24,679,338	9,532,650	85,793,852	17.352	58,963,283	57,106,514	17.352	9.497	7.855	4,631,565	24,679,338	23,810,625	1,870,324	6,501,889	238,106	2,941,088
Lb. Cu per ton		33.46		21.45	12.01	8.66	3.35	30.11		20.66						8.66	8.35				
Chino Copper Co.	2,379,800	102,569,380	66.588	68,293,893	34,275,487	24,018,549	10,256,938	92,312,442	17.420	64,857,788	64,293,893	17.420	7.240	10.180	6,605,576	24,018,549	22,817,621	2,322,834	8,928,410	228,176	2,833,948
Lb. Cu per ton		43.10		28.7	14.40	10.09	4.31	38.79		27.27	27.27					10.09	9.59				
Nevada Consol.	3,081,520	94,910,816	70.18	66,608,410	28,302,406	18,811,324	9,491,082	85,419,734	17.647	61,059,929	61,059,929	17.647	8.670	8.977	5,481,350	18,811,324	17,244,340	1,548,024	7,029,374	172,443	2,180,891
Lb. Cu per ton		30.8		21.6	9.2	6.12	3.08	27.72		19.80	19.80					6.12	5.61				
Miami Copper Co.	1,348,122	58,508,495	75.17	44,033,761	14,474,734	8,623,884	5,850,850	52,657,645	17.330	41,832,059	41,033,761	17.330	8.760	8.570	2,585,008	8,623,884	8,192,690	702,113	4,287,121	81,927	1,010,158
Lb. Cu per ton		43.4		32.66	10.74	6.40	4.34	39.06		31.02	31.02					6.40	6.08				
Total	18,152,711	594,931,717	66.6	396,257,954	198,673,763	139,180,590	59,493,173	535,438,544		396,257,954	375,140,065				$35,319,792	139,180,590	131,960,396	$12,504,082	$47,823,874	$1,319,603	$16,560,187
Average lb. Cu		32.7		21.8	10.9	7.7	3.2	29.5		21.8	20.6					7.7	7.3				

* From Annual Reports for 1915.

ORE RESERVES OF SIX PORPHYRIES, SHOWING RESULT OF FLOTATION APPLICATION

Name of Company	Tonnage Developed and Partly Developed	Contents Tons Cu	Recovery %	Present Method: Concentrates Tons Cu Recovered	Present Method: Tailings Tons Cu Lost	Minerals Separation, Ltd., Process with 90% Recovery: Concentrates Additional Tons Cu Recovered	Minerals Separation, Ltd., Process with 90% Recovery: Tailings Tons Cu Lost	Minerals Separation, Ltd., Process with 90% Recovery: Total Concentrates Tons Cu Recovered	Additional Copper Concentrates Tons Cu =	Additional Refined Tons Cu (95% Smelter Recovery)	Value per Lb. Cu Say Cents	Costs per Lb. Cu as per 1915 Report Cents	Profit Cu Cents	Additional Operating Profit	Estimated Additional Profit by Use of M.S. Processes. Costs @ 5c. per Lb.	Additional Profit for Each Cent Rise in Price of Copper Over 14c.
Utah Copper Co.	390,000,000	5,643,300	64.13	3,619,048	2,024,252	1,459,922	564,330	5,078,970	1,459,922	1,386,926	14.00	7.560	6.44	$178,636,068	$249,646,680	$27,035,520
Lb. Cu per ton		28.94		18.56	10.36	7.49	2.89	26.05	7.49	7.11						
Nevada Consol.	50,525,289	834,077	70.18	585,776	248,901	165,434	83,467	751,210 !	165,433	157,161	14.00	9.497	4.503	14,153,920	28,288,980	2,143,220
Lb. Cu per ton		33.04		23.19	9.85	6.55	3.3	29.74	6.55	6.22						
Chino Consol.	90,000,000	1,575,000	66.588	1,048,701	526,239	368,739	157,500	1,417,500	368,739	350,302	14.00	7.240	6.760	47,360,830	63,054,360	
Lb. Cu per ton		35.00		23.30	11.70	8.2	3.5	31.5	8.2	7.78						
Ray Consol.	71,911,475	1,607,221	64.11	1,030,389	576,832	410,110	160,722	1,441,499	410,110	389,304	14.00	8.670	5.330	42,139,406	71,154,720	
Lb. Cu per ton		44.7		28.65	16.05	11.37	4.47	40.12	11.37	10.83						
Miami Consol.	35,140,000	639,548	75.17	480,748	158,800	94,845	63,955	575,593	94,845	90,103	14.00	8.760	5.240	9,442,794	16,218,540	
Lb. Cu per ton		36.4		27.36	9.04	5.40	3.64	32.76	5.40	5.13						
Inspiration Copper Co.	74,000,000	1,272,800	70.00	890,960	381,840	254,560	127,280	1,145,520	254,560	241,832	14.00	8.13	5.870	28,391,076	43,529,760	
Lb. Cu per ton		34.4		24.08	10.32	6.88	3.44	30.96	6.88	6.53						
Total	711,576,764	11,572,546	66.16	7,655,682	3,916,864	2,759,610	1,157,254	10,415,292	2,759,600	2,621,628				$320,124,094	$471,893,040	$52,432,560
Average lb. Cu		32.52		21.52	11.00	7.75	3.25	29.27	7.75	7.36						

Ridge Mechanical Blende-Roasting Furnace

By H. M. Ridge*

In the article "Comments and Speculations on the Metallurgy of Zinc," in the *Journal* of Oct. 7, 1916, are discussed the important problems of the art of zinc smelting. Having been interested for many years in this industry and having been connected with the design and construction of various new works and plants in England and on the Continent, I would draw the attention of the profession to the details of improvements made on this side of the Atlantic.

During the last 15 years, Hegeler and Merton furnaces have been introduced, but have not made much headway. I needed furnaces in a smelting works with which I was connected, and not being able to obtain in the market anything that was entirely satisfactory, I carried on investigations and experiments in furnace design for several years. As a result, a mechanical blende-roasting furnace was developed and has since been supplied to five companies with satisfactory operating results.

Fig. 1 shows a longitudinal section, Fig. 2 a hearth plan and Fig. 3 a cross-section of this type of direct-fired furnace. The ore is fed continuously to the top hearth and is gradually dried by the heat from the top arch. Most of the ore treated carries lead, and unless it is dried gradually under continual stirring, lumps are formed which do not disintegrate in roasting. The dried and preheated ore is fed to the top roasting hearth and is raveled along this hearth, also the middle and bottom roasting hearths, and then drops to the cooling hearth to preheat the air required in the furnace. By cooling the ore before it leaves the furnace, heat units are saved and at the same time any tendency of the ore particles to stick together is overcome. The over-all length of the brickwork of the furnace is 56 ft.

Flotation concentrate from Broken Hill is treated in this furnace with a reduction of the sulphur content to about 1¼ to 1½%, with a fuel consumption of under 8%. One furnace treats 12 to 14 long tons per day, with a power consumption of ⅞ hp. and a small amount of cooling water. Only one man per shift is required.

Repairs on these furnaces have been small. On two furnaces during the last 2½ years, only two arms were broken and had to be replaced. Of course the rabbles which are in contact with the hot ore are renewed, but this does not interfere with the regular working of the furnace.

The cost of one of these furnaces before the war was £3000 erected complete with electric motor, so that the initial outlay compared favorably with the older designs of mechanical furnaces.

Most of the Ridge furnaces are muffled, so that the sulphur fumes can be made for making acid. Fig. 4 shows a cross-section through the muffled furnace. Rather more brickwork is required for this furnace than for the others, but with inexperienced labor it is easier to supervise, because good stoking is not so essential as with the direct-fired furnace. The fire gases leave the furnace at a high temperature and pass through a recuperator to preheat part of the air going to the furnace, while the rest of the air is preheated by the hot ore. The ore is warmed up sufficiently on the drying hearth so that it ignites as

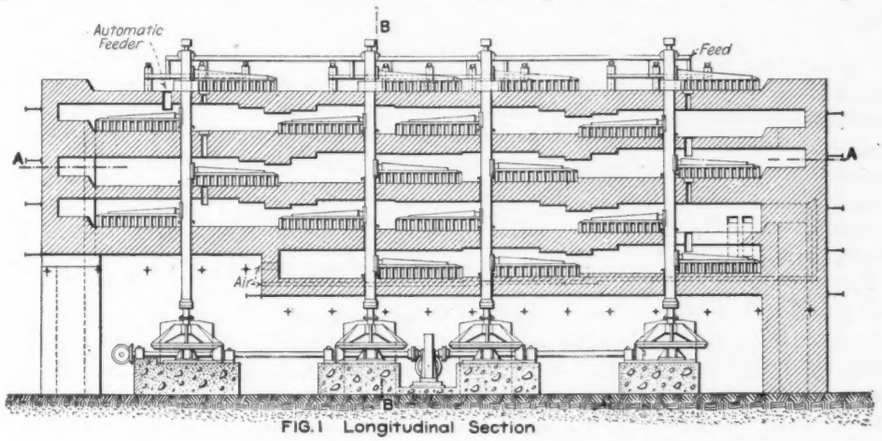


FIG. 1 Longitudinal Section

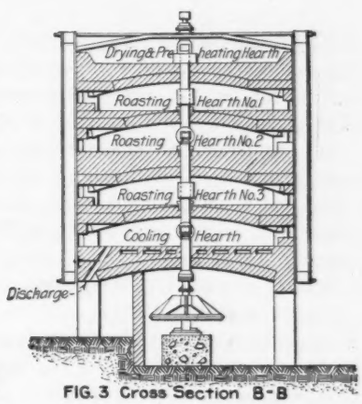


FIG. 3 Cross Section B-B

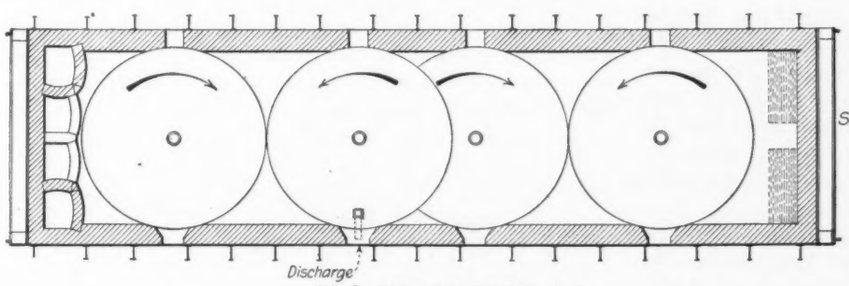


FIG. 2 Horizontal Section A-A

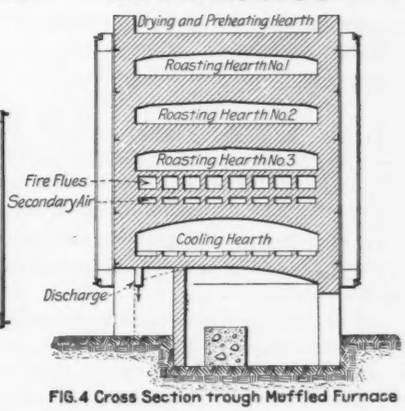


FIG. 4 Cross Section trough Muffled Furnace

DETAIL SECTIONS OF THE RIDGE MECHANICAL BLENDE-ROASTING FURNACE

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soon as it enters the top roasting hearth; the sulphur fumes thus leave the furnace at a high temperature.

The mechanical details are extremely simple. Each of the four shafts is made in one piece, and the arms are fixed to the shaft in such a way that they can be renewed easily when necessary. The driving gear is placed on a solid foundation away from the heat and is protected from the dust. The main driving wheels are independent of the shaft, which can be raised or lowered at will.

Being able to reduce the sulphur content further than is possible in the best hand furnaces was not expected, but is accomplished on a wide variety of ores. One smelter had much trouble with a highly ferruginous blende; in the hand roasters the average sulphur was 3¼%, but in the mechanical furnace as low as 2¼% could be obtained without difficulty. On good ores the sulphur can be reduced to 0.7% and 0.6% without any difficulty.

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Mineral Deposits of Tuscany

By Waldemar Lindgren

In two interesting pamphlets[1] P. Toso discusses the various mineral deposits of irregular or stratified form which occur in the interesting metallogenetic province of Toscana (Tuscany) and the deposits of petroleum and sulphur, in the light of experience gained in the earlier investigations. The author believes in the efficacy of magmatic emanations, and he regards deposits of sulphur and oil, as well as metalliferous ores, as having originated from these emanations. The publications are not exactly objective descriptions, but present arguments to support a stated thesis.

The deposits of the Massetano region are metalliferous veins and contact deposits of various kinds, carrying pyrite, chalcopyrite and quartz. Many of the contact deposits are found between Permian schists and the overlying Eocene limestones or parallel to the bedding of the latter. The author advances his view that these deposits are caused by gaseous superheated emanations finding their way upward through simple fractures and then sideways on faults or contacts between the formations along which there has been extensive crushing and movement. The often-found thick ore beds are explained by the theory that the gaseous emanations have filled the openings gradually and contemporaneously with the faulting movements.

In this connection attention is drawn to the fumaroles, or *soffioni*, of superheated vapors carrying boric acid which occur in the same region, and which pyritize and otherwise alter the Eocene marls which they traverse. Some of the *soffioni* which contain much water vapor have a temperature of 100° C., but others issue with a temperature of up to 190° C. and with a pressure of from two to four atmospheres. The lines of the *soffioni*, as well as those of the ore deposits, correspond with the structural and tectonic lines of the region. The author concludes that such *soffioni* have formed the ore deposits. For some deposits the theory of replacement advocated by Lotti is admitted, but the majority are deposited by filling contemporaneously with the opening of the faults.

The quicksilver deposits of Monte Amiata are, on the contrary, attributed to ascending springs of lower temperature, which may even, upon reaching the surface, descend into porous strata, and thus the deposits may have been formed by locally descending waters. In the closing chapter the author applies his theory to other deposits, like those of Elba, Agordo and Monte Catini.

Taking up the study of the petroleum deposits, the author deduces to his own satisfaction that they are primarily caused by emanations of hydrocarbons from deep-seated magmatic sources, but to the reader the actuality of these emanations of hydrocarbons in large volume seems far from being established. The sulphur deposits of Sicily, Louisiana and Texas, and Mexico are next examined, and the conclusion is reached that similar magmatic emanations of hydrocarbons carrying, besides, silica and strontium have reduced beds of gypsum with formation of calcium carbonate and native sulphur. In general, therefore, the theory of the author is similar to that of Baldacci.

It is recognized, however, that certain sulphur deposits like those of Murcia in Spain and Lornano, near Siena, in Italy, are of different origin and probably were deposited as sediments, perhaps by reduction of gypsum beds, by carbonaceous material present at their time of formation.

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Dinner to Hoover at Hotel Astor

Six hundred persons, including many of the mining profession, gathered at a testimonial dinner given to H. C. Hoover at the Hotel Astor, New York, Feb. 13. There were only two speakers, Nicholas Murray Butler, president of Columbia University, who gave a glowing tribute to Mr. Hoover and to the Belgian nation and Mr. Hoover himself.

It was a most impressive speech in which Mr. Hoover told about humanity's work in Belgium and he was noticeably affected by the news that the Germans had ordered out of Belgium the little army of the commission, and throughout his speech his voice shook with emotion until he could hardly be heard at the rear of the room.

"You will ask," he said, "what will happen in case of war. The Relief Organization is not a single individual; it is an army, comprising over 55,000 volunteers, at present under the direction of American officers. It depends upon the whole world for its support. If it is necessary for Americans to retire in favor of some other neutrals, the obligation upon the world will remain. The world cannot resist the call of 6,000,000 of women and children for the bare subsistence of life. God still reigns, and no matter what our temporary difficulties may be, the same faith and the same force which has enabled us to go thus far will enable these people to be saved. Whether at the hands of this particular group of men, or at the hands of whatever neutral nation to whom the responsibility for administration of the work falls, the obligation of the American people to support such an administration, and thus to support these people, is no less than if it should happen to be directed by Americans themselves. There can be no slackening of our endeavors; there can be no relaxation of our responsibility in this matter."

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[1] "Sul modo di formazione dei principali giacimenti metalliferi aventi forma di irregolari ammassi v di strati, coltivati in Toscana ed in altre regioni d' Italia," by P. Toso; pp. 122; Estratto dal Bollettino del R. Comitate Geologico, Vol. XLII, fasc. 3 and 4, Roma. 1913. "Sui modo di formazione dei giacimenti petroliferi e solfieri," by P. Toso; pp. 92; Estratto dal Bollettino del R. Comitate Geologico, Vol. XLV, fasc. 1 and 2, Roma, 1916.

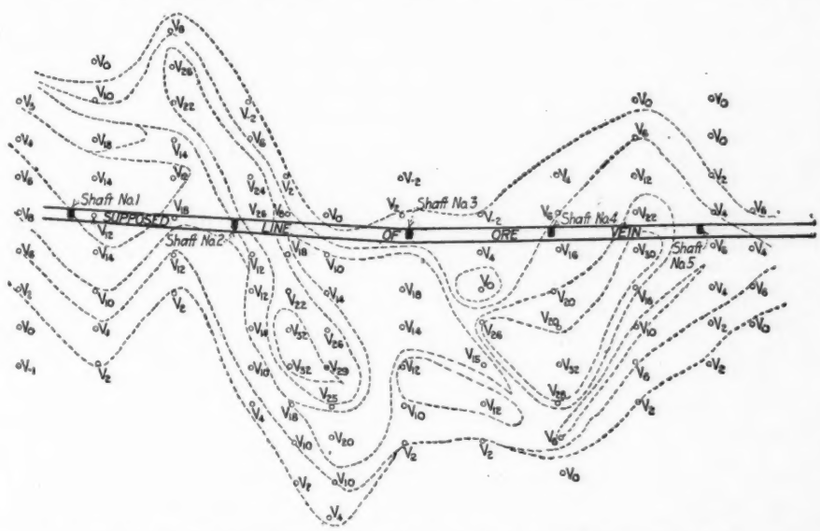
Magnetometric Survey Method

By J. F. Kellock Brown*

The magnetometric system, as applied to the exploration of magnetic iron ores, as is well known is a scientific development of the old-fashioned dip needle. The instrument employed differs from the dip needle in the accuracy of the instrument itself, in its ability to take successive readings constantly in the same vertical and also in the same horizontal plane, and under a definitely known attraction, and in the taking of the readings at properly measured and accurately laid-out distances. In the hands of experienced operators it is capable of determining not only the direction of the deposit and its area, but also its depth and from that some idea of the quantity of ore available. But there are no doubt many cases where much rougher work would be just as valuable, provided there were some means of accomplishing it, particularly in view of the fact that the magnetometric instrument is a costly one to acquire when perhaps it may only be of use once or twice in many seasons' work.

The magnetometric system is, after all, a relative method. It is a method of surveying whereby the effect of ground known absolutely not to contain magnetic mineral is compared with the magnetic-ore ground, and the depth, width and extent of the deposit and its consequent outline are arrived at by plotting the variations in the readings obtained and compared, with those predetermined from the nonmineralized ground. It is obvious that the readings of such an instrument, taken outside the ore district, provided that they are always taken in the same planes, will always be the same, and further that any attraction of the needle caused by an artificially introduced magnet, such as is used in conjunction with the magnetometric instrument, will also be constant. But immediately when the instrument comes within the magnetic field created by the iron orebody, the readings recorded begin to vary in proportion to the proximity of the instrument to the orebody. It is on the difference between the figures read before approaching the orebody and those read while within the magnetic field that the engineer bases his deduced results. It appears as if there were really three readings to watch—the effect of the draw of the ore upon the needle while the instrument is fixed in a certain constant direction, the same thing under attraction brought about by the use of a magnet, and the effect of attraction on the needle while in the same constant vertical plane.

On a magnetic-ore prospect, many miles back in the woods, it was the desire of the engineers to find out something about the shape of the deposits and, if possible, the depth before proceeding to do deep shaft work. Unfortunately, there was no magnetometric instrument available anywhere, but a theodolite and an ordinary dip needle were on the ground. With these two a sort of combination instrument was built which answered the purpose fairly well, giving rough comparative readings that in relation to each other were quite in proper accord. To do this the dip needle was set up on the theodolite between the pillars and in the axis of the telescope, which was removed for the time being. Of course the needles attracted each other, but this attraction was a constant as long as the instrument was outside the influence of the orebody and as long as the instrument was constantly operated and read in the same vertical plane. A few degrees either way caused a fresh set of constant variations to become operative. The deposit was a supposed narrow vein of ore approximately 8 to 15 ft. in width, and it had been proved by a number of surface pits sunk through heavy surface covering and placed at distances of 300 to 400 ft. apart, as shown in the accompanying sketch. From this the orebody was assumed to be a continuous deposit running practically in a straight line. Immediately when the improvised magnetometric instrument went into operation, it proved the shape otherwise and indicated that the supposed straight vein was a series of pockets, or lenses, with only slight connection, twisting this way and that in the ground. This rather upset the idea of the work to be undertaken, and to prove the matter, a proper magnetometric instrument was purchased and used upon the ground, confirming the results of the home-made instrument. The sketch shows the difference between the supposed orebody and what it was found to be.



OUTLINES OF OREBODY AS INDICATED BY MAGNETOMETRIC SURVEY

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Bauxite Brick

At a steel foundry an experiment was made using 3500 76% Al_2O_3 bauxite brick in the side wall of a tilting openhearth furnace. The result showed the durability of bauxite brick to be fully on a par with the formerly used magnesite brick, while the cost of the bauxite was lower. For use in copper furnaces, a laboratory experiment was made for comparative results between bauxite and magnesite brick, both being tested with blast furnace and reverberatory matte. The results, according to the Laclede-Christy Clay Products Co., were as follows: No fusion or fluxion occurred in either case; the slag penetrated the magnesite brick 2 in. and the bauxite brick ½ in.

Editorials

Ray Consolidated

Up to the end of 1915 Ray Consolidated, with a reported ore reserve of 71,911,475 tons, estimated as averaging 44.7 lb. copper per ton, had mined and milled 9,902,890 tons, yielding 219,293,568 lb. of copper, an average of 22 lb. per ton. It has been well known that the Ray ore has presented certain difficulties in concentration, especially owing to the occurrence of oxidized copper. It has been known, moreover, that the Ray, like the other Jackling copper properties, has suffered from backward metallurgical practice, especially owing to delay in adopting the flotation process. Yet in reviewing the figures that represent the extraction of nearly 12% of the estimated ore, it is decidedly a shock to find that the extraction of copper apparently has been only 50%, and one is immediately prompted to consider what may be the explanation of this astonishing figure.

The first thought is naturally that the principal—that is, the ore estimated as being developed and the copper content thereof—is incorrectly stated. Such an estimate is admittedly only an approximation. It has been the invariable experience with the porphyry coppers that the ore milled has never come up to the sampling of the orebody. For this there are two chief reasons, both of them good. One is that in mining there is unavoidable admixture of waste, reducing the grade. The other is that as the orebody is extracted to the limiting line of the estimate, there is often found ore of lower grade beyond that line, which may still be mined profitably, and of course that is done. While both of these conditions reduce the average grade of the ore, they increase the tonnage, and it has also been the invariable experience of these mines that tonnage exceeds the original estimate.

The last quarterly report of Ray Consolidated, bringing its record up to the end of 1916, throws light on these things in its case and also communicates encouraging information as to the steps that have been taken to improve its metallurgical practice. On the subject of ore reserves it is said:

> During 1916 the ore reserves of the mines have been recalculated with a view to including certain areas and zones of ore which were not included in original calculations or in estimates shown in previous reports. Some of these ores were of grades lower than it was thought conservative in original estimates to accept as profitable. Others were insufficiently proven or so located that it was not considered proper to class them as fully developed and available reserves until by extended underground development and mining experience it was proven that they were practically and commercially available. All these things have now been demonstrated to an extent justifying a revision of the available ore reserves by adding over 20,000,000 tons of ore having an average copper content somewhat in excess of 1.5%. Practically all the tonnage so added lies within areas formerly reported as fairly developed by drilling. Final figures pertaining to this readjustment of ore-reserve estimates are not now available, but they will appear in the forthcoming annual report. In general terms the results will show over 91,000,000 tons of ore reserves remaining on Dec. 31, 1916, the average copper content of which is approximately 2.05%. Up to the date stated considerably over 13,000,000 tons of ore had been mined, and accordingly the total ore developed in the property up to the end of the year closely approximates 105,000,000 tons.

At the end of 1915 there was estimated 71,911,475 tons of ore containing 1,607,221 tons of copper. During 1916 there was mined about 3,400,000 tons yielding about 38,000 tons of copper. But at the end of 1916, in spite of the extraction of upward of 13,000,000 tons of ore, the mine is refigured as still containing 91,000,000 tons of ore, containing 1,865,500 tons of copper.

On the subject of mill extraction, it is reported that the average recovery from concentrating ores during the last quarter was 75.32% of the total copper contained in such ores. The president and managing director express some jubilation when they add, "This is the best metallurgical result achieved in the company's history and corresponds to an extraction of approximately 83% of the copper contained in unoxidized form." The hope is held out that even better results may be expected as further progress is made with the improvements.

While developed tonnage is commonly understated and average grade overstated, as already explained, another important element—cost of production—is generally understated. The reasons for this involve a discussion that would exceed the length of this article. The Ray cost for the last quarter is figured by the company at 9.769c. per lb. of copper. Wages were more than 40% above the usual scale, and supply costs were also much in excess of normal. The officers of the company say that if usual operating expenses had been applied to the quarter the cost per pound of copper would have been below 8c. However, we figure from a consolidation of all the annual reports of the company from the beginning up to the end of 1915 its real cost was about 10¼c. per lb.—this for the production of about 220,000,000 lb. of copper.

Universal Military Training

A bill for universal compulsory military training has been reported to the Senate from the Committee on Military Affairs. This measure, fathered by Senator Chamberlain, was drafted with the assistance of Maj. George G. V. H. Moseley, formerly a member of the general staff of the Army, and has been under consideration by the committee for several weeks. The bill provides that upon reaching the age of 19 years all male citizens and those who have taken out their first naturalization papers, who have no dependent relatives, shall put in six months, without pay, in military training.

The bill disagrees with the theory of the Army General Staff as to the amount of training necessary to make a soldier fit to go into the firing line. Major General Scott, the chief of the staff, believes that one year of intensive instruction is the safe minimum for training.

Another bill for universal training, carrying the indorsement of virtually the entire membership of the General Staff and based on a year's training, is almost ready for final submission to the Secretary of War and the President, who are not yet committed to the principle.

It is not expected that either bill will be acted upon at this session of Congress. With the mistakes of England in this direction plain in front of our eyes, and the agonies through which she has been going for almost three years as a consequence; with our foreign relations in the delicate condition in which they are; and with war for this country almost universally expected, it is difficult to comprehend the state of mind of our national legislators in delaying on this vital matter.

As between the two bills, although we have seen neither, we incline to the belief in this, as in other matters, that the bill approved by the board of experts, in this case the General Staff, is the one which should have consideration. We have at the present a military law (the Hay bill) on our statute books which is the product of political efforts and political minds, to the exclusion of advice by military experts, and we have seen it utterly fall down during the past eight months when the National Guard has been concentrated on the Mexican border. That experience of eight months has of itself shown that that period of time is not long enough to make a thoroughly efficient soldier, and what is more, under anything like our present military establishment that length of time is hardly a beginning.

One year of a young man's life at the age of 19 or 20 is to him of the least value of any year in his career, although youth, taking itself very seriously, does not often think so. One year's intensive military training at this period of a career would fit any young man much better to take up either four years' study in college or to plunge into the hard school of experience for his education and livelihood. He would have straighter shoulders, harder muscles, a deeper chest and a more democratic feeling, and he would have fewer cobwebs in his brain. One year under canvas and under intensive military training of regular army officers would make a man of him if there were anything at all to begin with, and would go a long way toward making him a thoroughly first-class soldier.

We should have universal military training; the intensive period should not be less than one year; and it should begin at once.

Always Room at the Top

Why is it that there is a dearth of men to fill important high-salaried and responsible positions, concerning which we have so many platitudes and hear so many sermons? Too little attention is paid by the big corporations to developing men for specific places. Probably a large percentage of the graduates from our technical institutions, if properly handled by their employers, could be made very much more valuable than they now are. It is almost an axiom that the better assayer or surveyor or draftsman a man is, the more certain is he to stay in that rut and never be anything else.

We have in mind specific instances where men have shown particular aptitude in lines similar to the above and were considered so valuable to the institution that they would not be surrendered voluntarily to another concern which needed that particular kind of talent, nevertheless the company did not increase the men's salaries (which is not the point in this argument), but did not give them any wider sway in its own affairs. When one of these young men with the advantage of the technical training which is gained at our admirable institutions shows particular adaptability in his work, his superior makes a mistake if he simply congratulates himself on the fact that he has a good man. He should rather change him from one department to another, with the definite idea of broadening and developing him and making him into a big man.

That such a thing can be done out of ordinary human material is shown by the Army and the Navy, more especially the latter. There have been many times in our history when navy officers have acquitted themselves in delicate diplomatic matters abroad much to our pride and satisfaction. High naval commanders have a tremendous task in their organization and executive problems, and it is rarely that such a man in such a position fails to deliver the goods. The reason is because he is systematically developed for that very position, from the beginning of his training as a student at Annapolis. His entire work and career is progressive, so that when in the course of time age brings him to positions of supreme command, he has been through all the nether departments and the progressive training of a lifetime counts. He is not isolated; he is only one of a class, average ordinary material at the start, but at the finish he is a product of continuous logical development.

If our mining and metallurgical companies would, instead of considering some of their employees so good that they cannot be replaced, consider them so good that they ought to be put somewhere else, it would be much better for all concerned.

The Advance of Flotation

Since the recognition of the practicability of the flotation process, the amount of interest attracted to it has been so great that other metallurgical methods have suffered by the neglect. Flotation has absorbed all the propulsive effort that was formerly divided among many processes, and while this has resulted in a notable advance in the new system, it has also unduly emphasized its advantages and obscured the real value of the others.

Flotation has been like a good many other processes. At first nobody had much confidence in it, but a devoted few stuck to its development and proved that it had real value. After this value had been clearly demonstrated, it began to invade all fields, and not long ago its impetus was so great that almost any kind of ore anywhere was considered a field for its application. Since no metallurgical process, however, has ever been made to apply with equal success to all kinds of ores, the reaction began. It is under way now, and metallurgists are recognizing the fact that it is not the best process for some of the ores to which it is being applied, and that it may prove best applicable to some ores upon which it has been used little or not at all.

Some of the problems that are occupying the attention of metallurgical workers now include the possibility of applying flotation, instead of cyaniding, to the silver-sulphide ores of the West and of Mexico. In many cases where the silver occurs exclusively as sulphide, including most of the great mines of Mexico, it appears to be possible to concentrate by flotation and smelt the concentrates at a less ultimate cost than cyaniding involves. In the case of some of the isolated mines it may even be expedient to cyanide the concentrates rather than ship them to a smelter, making bullion as a final product.

On the other hand, some of the copper ores of the West may be better handled by leaching. In a case of this kind it is a question of examination of the problem from all points, and the cost and extraction percentage by flotation must be compared with the cost of the details of leaching, including roasting where that is necessary, the cost of acid, cost of precipitation, and all other details. It is to be remembered, also, that the leaching process results in marketable bullion, whereas flotation, in itself, does not. The percentage of extraction, too, is likely to be somewhat better with leaching. At any rate it is recognized that there is a question, and it will be necessary to devote careful study to determine whether it will be better to apply flotation or some one, or combination, of the older systems. The latter are still reliable.

BY THE WAY

A bridge nearly a mile long is being built by the Russian and Swedish governments over the River Tornea, which separates Sweden and Finland at the apex of the Gulf of Bothnia. The Swedish government is doing the actual work, having better access to material. By this bridge the railway systems of the two countries will be united, and one may then be able to travel from Stockholm to Vladivostok without alighting from the railway coach. The bridge is nearly completed.

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At the last meeting of the Rhodesian Munitions and Resources Committee, some examples of dog spikes and nails were shown which had been manufactured on the Rezende Mines from old wire ropes, says the *South African Mining Journal*. The work was done by native drill sharpeners, and all the mine requirements for the past six months in heavy nails and dog spikes were manufactured at a cost of less than 2d. per lb. The present market price of these was about 6d. per lb. The rope, of suitable diameter for size of nails or dog spikes required, was cut up into suitable lengths for handling. About 6 in. of the end was heated and welded on the anvil, using dry slime as a flux and the welding process continued until a bar was completed. The making of these bars was done by the native drill sharpener when carrying out his ordinary routine of drill sharpening. The rest of the work necessary—drawing down the points and shaping heads—was done when drill sharpening was not going on, and as on most mines the drill sharpener is not engaged all the time, there is sufficient margin to carry out this work. The heads were shaped in a blacksmith's vise, but the work could be done quicker and better if a few simple tools were made. No difficulty was experienced in welding, and the ordinary native drill sharpener can quickly master it. The nails are of the same type as cut nails, but heavier, and would be very suitable for heavy timber work, particularly native timber, as they do not bend when being driven.

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The first gold medal of the Mining and Metallurgical Society of America was awarded to Mr. and Mrs. H. C. Hoover and presented at a notable and elaborate dinner in the Biltmore Hotel in New York in 1914, at which a large number of ladies were present. The second gold medal was awarded in 1915 to Prof. R. H. Richards and was presented at a dinner held at the Chemists' Club, New York, to which ladies were not invited. The third medal was awarded to Prof. J. F. Kemp and, on account of his ill health, was presented to him at his home in New York by a committee delegated by the council of the Society. It was announced at the annual meeting of the Society in January, 1917, that the fourth gold medal had been awarded to E. P. Mathewson, the date of presentation to be announced later. Owing to the existing circumstances and the fact that Mr. Mathewson is a native of Canada and a graduate of McGill University and that he has just returned to Canada to head an important metallurgical enterprise there, though still retaining his American citizenship, it has been decided to make this presentation at the annual dinner of the Canadian Mining Institute to be given Thursday evening Mar. 8, during the session of the Institute extending from Mar. 7 to 9 inclusive. It is sincerely to be hoped that a large number of American mining engineers will take this opportunity to attend the meeting of the Canadian Mining Institute and join in making the presentation to Mr. Mathewson as noteworthy an occasion as it deserves to be under these unusual and interesting circumstances.

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The Ballad of the Torn Boots

By Charles Nicholls Webb

"Look at them boots," said Cap'n Dan,
"Look at the way they're tore!
They was wore by as careful a man
As ever shoveled ore.

"Careful 'e was, but a single break
'E made on a busy day,
The foolishest kind of a fool mistake
That a man can make, I say.

"'Urried and rushed to reach the top;
Ladder route, then, was too slow,
Runs to the skip and gives an 'op,
Just as she starts for to go.

THE LESSON OF THE TORN BOOTS

"Catched 'e was 'twixt plate and skip,
Catched by the feet, you see—
Something gives with a mighty rip;
Out 'e pulls scot-free.

"Lucky 'e's got any bloody feet;
That they wasn't took clean away.
'Don't ride the skip' is a rule that's neat;
Orders is made to obey.

"Look at 'is boots," said Cap'n Dan,
"Learned 'im a thing, you bet!
Never 'as been so careful a man
As couldn't be carefuller yet."

New Publications

Estadistica Minera en 1914. By Carlos P. Jimenez. Pp. 150. Bull. 82, Cuerpo de Ingenieros de Minas del Peru, Lima.

Report on the Fertilizer Industry. Pp. 269; illus.; 50c. U. S. Federal Trade Commission, Washington, Aug. 19, 1916.

Operating Details of Gas Producers. By R. H. Fernald, 6x9, pp. 74, paper. Bull. 109, U. S. Bureau of Mines, Washington.

The Yukon-Koyukuk Region, Alaska. By H. M. Eakin. Pp. 88, illus. Bull. 631, U. S. Geological Survey, Washington, D. C.

Summary Report of the Mines Branch, Canadian Department of Mines, for 1915. Pp. 213, illus. Canadian Department of Mines, Ottawa.

Review of the Geology of Texas. By J. A. Udden, C. L. Baker and Emil Böse. Pp. 164; illus. Bull. 44, University of Texas, Austin, Aug. 5, 1916.

Bibliography of Australian Mineralogy. By C. Anderson. Pp. 164; 2s. 6d. Mineral Resources No. 22, New South Wales Geological Survey, Sydney.

The Analytical Distillation of Petroleum. By W. F. Rittman and E. W. Dean. 6x9, pp. 79, illus.; paper. Bull. 125, U. S. Bureau of Mines, Washington.

Preliminary Oil Report on Southern Illinois. By Albert D. Brokaw. 7x10, 13 pp., paper. Extract from Bull. 35, Illinois State Geological Survey, Urbana, Ill.

Magnesium in 1915. By Frank L. Hess, 6x9, pp. 735-741 of "Mineral Resources of the United States," 1915, Part I; paper. U. S. Geological Survey, Washington.

A Study of Oil Engines in Iowa Power Plants. By H. W. Wagner. Pp. 159; illus. Bull. 42, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.

Elementary First Aid for the Miner. By W. A. Lynott and D. Harrington. 6x9, pp. 23, illus.; paper. Miners Circular 23, U. S. Bureau of Mines, Washington.

Prospecting and Mining of Copper Ore at Santa Rita, N. M. By Donald F. Macdonald and Charles Enzian. 122 pp., illus. Bull. 107, U. S. Bureau of Mines, Washington.

Mineral Resources of Alaska, Report on Progress of Investigations in 1915. By Alfred H. Brooks and Others. Pp. 279, illus. Bull. 642, U. S. Geological Survey, Washington.

Gypsum in the Southern Part of the Bighorn Mountains, Wyoming. By C. T. Lupton and D. D. Condit. Pp. 20, illus. Bull. 640-H, U. S. Geological Survey, Washington, D C.

The Gold Hog Mine, Talladega County, Alabama. By Edson S. Bastin. 6x9, pp. 159-161 of "Contributions to Economic Geology," 1916, Part I; paper. Bull. 640-I, U. S. Geological Survey, Washington.

Tin Ore in Northern Lander County, Nevada. By Adolph Knopf. 6x9, pp. 125-138 of "Contributions in Economic Geology," 1916, Part I; paper. Bull. 640-G, U. S. Geological Survey, Washington.

Geological and Mineral Resources of Curry County, Oregon. Preliminary Survey of the. By G. M. Butler and G. J. Mitchell. Pp. 132; illus. Oregon Bureau of Mines and Geology, Corvallis, Ore., 1916.

Geology of the Upper Stillwater Basin, Stillwater and Carbon Counties, Mont., with Special Reference to Oil and Gas. By W. R. Calvert. Pp. 18, illus. Bull. 641-G, U. S. Geological Survey, Washington, D. C.

California Mineral Production for 1915. With Mining Law Appendix and County Maps. By Walter W. Bradley, Mining Statistician. Pp. 193; illus. Bull. 71, California State Mining Bureau, San Francisco, 1916.

Sampling Metallic Metallurgical Materials, The Principles and Practice of, with Special Reference to the Sampling of Copper Bullion. By Edward Keller. 102 pp., illus. Bull. 122, U. S. Bureau of Mines, Washington.

Relations of the Ember and Chug-Water Formations in Central Wyoming. By D. Dale Condit. 9x11½, pp. 263-270 of "Shorter Contributions to General Geology" 1916; paper. U. S. Geological Survey, Washington.

Geology and Paleontology of San Juan County, New Mexico, Contribution to the. Stratigraphy of a Part of the Chaco River Valley. By C. M. Bauer. Pp. 10, illus. Prof. Paper, 98-P. U. S. Geological Survey, Washington, D. C.

The Golden Arrow Clifford and Ellendale Districts, Nye County, Nevada. By Henry G. Ferguson. 6x9, pp. 113-123 of "Contributions to Economic Geology," 1916, Part I; paper. Bull. 640-F, U. S. Geological Survey, Washington.

Physical and Chemical Properties of Gasoline Sold Throughout the United States During the Calender Year 1915. By W. F. Rittman W. A. Jacobs and E. W. Dean. 6x9, pp. 45, charts; paper. Technical Paper 163, U. S. Bureau of Mines, Washington.

Heaton's Annual. The Commercial Handbook of Canada and Boards of Trade Register, 1917. 4½x7¼, pp. 518; $1.25. Heaton's Agency, Toronto, Canada.

Contains statistics relative to the industrial and economic conditions in the provinces of Canada; 18 pages are devoted to mineral production figures and location of minerals of economic importance.

Parts of Mineral Resources of the United States, 1915. Iron Ore, Pig Iron and Steel in 1915. By E. F. Burchard. Pp. 67, illus. Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1915. (Mines Report.) By C. W. Henderson. Pp. 19. Gold, Silver, Copper, Lead and Zinc in Utah in 1915. (Mines Report.) By V. C. Heikes. Pp. 40. U. S. Geological Survey, Washington, D. C

Report on State Water Problems Conference. Pp. 125. Presented to the Governor of California, Nov. 25, 1916. California State Printing Office, Sacramento.

The Conference acted under instructions of the California Legislature to recommend "a unified state policy with reference to irrigation, water storage, flood control, municipalities and drainage, with due regard to the needs of water power, mining and navigation."

Bulletin of the New York State Museum, July 1, 1916. Pp. 192, illus. Bull. 187, University of the State of New York, Albany.

This bulletin contains the twelfth report of the director of the State Museum and Science Department, including the sixty-ninth report of the State Museum, the thirty-fifth report of the state geologist and the report of the state paleontologist for 1915; also the following scientific papers: Landslides in Unconsolidated Sediments, by D. H. Newland; Albany Molding Sand, by D. H. Newland; On the Genus Urasterella and Description of a New Species, by G. H. Hudson; Ancient Water Levels of the Crown Point Embayment, by E. E. Barker.

Outlines of Industrial Chemistry. By Frank Hall Thorp, with assistance in revision from Warren K. Lewis. 5¾x8¾, pp. 665 + XXV, illus. $3.25. The Macmillan Co., New York.

The progress of the chemical industries has rendered necessary another revision of this standard book. No attempt has been made to render it a treatise for specialists. It still remains merely a general textbook for the student and a guide for the engineer who needs only a superficial knowledge of certain processes. The plan remains as before—to touch lightly on every one of the great chemical and metallurgical industries. The book should continue to hold the enviable position the previous editions have enjoyed in their time.

Economic Geology. By Heinrich Ries. 5½x9, pp. 856, illus. John Wiley & Sons, New York.

This work is about equally divided, half to nonmetallics, coal, clays, fertilizers, etc., and half to ore deposits, which, besides the metals of major importance, include also such minor metals as aluminum, manganese, mercury, antimony and vanadium. The book, though strictly technical, is very interestingly written and is a valuable addition to the literature of the subject. It deals only with the economic side of geological occurrence of these deposits and such specific structural and physiographical features as are necessary to the topic. The illustrations are copious and illuminating, and very few of them could well be dispensed with. It is the latest book on the subject and well done.

Field Geology. By Frederic H. Lahee. 5x7½, pp. 508, illus., leather; $3. McGraw-Hill Book Co., New York.

This book, leather-bound and of pocket size, is the kind an engineer is glad to put in his war bag when starting on a mine examination or a reconnaissance. It will help untangle many a knotty problem that otherwise would be put off and then sidetracked altogether. The book presupposes an elementary knowledge of geology and the common rocks, but is also a valuable adjunct for the beginner. It deals solely with field geology and omits the usual textbook stuff. It is unusually replete with line drawings, sketches and block diagrams. There are chapters on topographical and geological surveying and geological computations that are unusually welcome. The book fills a long-felt want and will be welcomed by mining engineers everywhere.

Fundamentals of Military Service. By Capt. Lincoln C. Andrews, 4½x7¼, pp. 428, illus., leather; $1.50. J. B. Lippincott Co., Philadelphia, Penn.

Major General Leonard Wood asked Captain Andrews to write this book and it ought to be read by every United States citizen. There would be no further idiotic utterances by public men about "million armed citizens springing," etc. There are several chapters that are technical and deal with specific military duties, but they are interesting and enlightening. The chapters that are not technical are very illuminating and give a comprehensive idea of the requirements of our national defense. There is a chapter on the Engineer Corps, devoted almost exclusively to field intrenchments, and there is one chapter on Horsemanship, which is worth the price of the book to any mining engineer who has riding to do.

The Metallurgy of Steel. Vol. I, Metallurgy, by F. W. Harbord; Vol. II, Mechanical Treatment, by J. W. Hall. Pp. 522 and 411; 6x8¾; illus. Charles Griffin & Co., Ltd., 1916.

The first edition of this work appeared in 1904, but the appearance at this time of the fifth edition does not alone show the important place which it has made for itself in the literature of iron and steel. It is the most recent book taking up in detail the manufacture of steel and the only recent one going exhaustively into the subject of the mechanical treatment of steel. There have been no special developments in the manufacture of iron and steel since the last edition of this book in 1912, but advances have been made in details, and these have been reviewed in the fifth edition, especially the manufacture of chemically pure iron in the basic openhearth furnace from phosphoric pig iron; methods of producing sound ingots and for decreasing segregation. The chapter on the manufacture of armor plate and that on the theory of iron and steel have been largely rewritten, and the latter contains material contributed by Prof. H. C. H. Carpenter, dealing with the stress theories of hardening.—Bradley Stoughton.

The Deposits of the Useful Minerals and Rocks, Their Origin, Form and Content. By F. Beyschlag, J. H. L. Vogt and P. Krusch. Translated by S. J. Truscott. Vol. II. 6x9, pp. 1262 illus.; $5 25. Macmillan & Co., Ltd., London, 1916.

The second volume of Truscott's translation of the great work by Beyschlag, Vogt and Krusch has recently appeared. It forms a substantial book of 1262 pages, with a rather scant number of 176 illustrations. The promised third volume of the original has not so far appeared, but the two volumes in hand form a complete description of the metallic ores and their deposits. The translation is very well done and the figures, in general, are satisfactory. The English edition is welcome to many who cannot easily use the original. The work is the most modern description of the ore deposits of the world so far issued, and it is rich in quotations and references. In the present publication one notes the omission of description of some important deposits. The Homestake mine, of South Dakota, though working one of the great gold deposits in the world, is not mentioned, nor are the siliceous replacement ores in the same region described. The gold-bearing veins of Mysore, India, are apparently overlooked, though so many interesting data are available in regard to them. Looking at the work from an American standpoint, it is regrettable that none of the authors has had experience on this continent. Professor Vogt has handled the extensive American literature with great skill which however, cannot quite replace personal acquaintance. The work is not based on a genetic classification, but the deposits are described by metals, probably the only practicable way in a work of this kind. These criticisms do not materially detract from the volume as a most welcome source of information, indispensable to every student of ore deposits.

The Fundamental Principles of Petrology. By Ernst Weinschenk. Third Edition, translated by Albert Johannsen. Pp. 214, illus.; $2.50. McGraw-Hill Book Co., New York, 1916.

The need of a short presentation of the fundamental principles of petrology as applied to geology has suggested to Professor Johannsen the translation of the first volume of Weinschenk's "Grundzüge der Gesteinskunde," and it is certain that the American literature of petrography is distinctly enriched by this work. If the numerous illustrations in places leave something to desire, this is explained by the difficulty of obtaining the original electrotypes. There are many most excellent reproductions of types of rock structures, which lend great value to the publication. Some of the sections across volcanoes and intrusions are of ancient vintage and generally without scale or with the vertical features grossly exaggerated. The translation is good, though not always above criticism. An excellent feature is the placing of the references to important literature at the beginning of the chapters.

The book covers petrology in its widest sense, hence sediments and metamorphic rocks as well as weathering, thermal alteration and contact metamorphism are given proper consideration. In the words of the author, petrology is the study of the origin, present condition and decay of rocks. The strong individuality of Professor Weinschenk is apparent throughout the book, and some views are advanced that will not meet with universal approval among the geologists of this country. The book is a forceful rather than impartial presentation of the subject. American literature is scantily represented and the views of American investigators often receive short shrift. For these and other reasons the work is scarcely suitable for a general textbook, but no advanced student can fail to derive an immense benefit from the perusal of its virile chapters.

The author is a strong upholder of the theory of the powerful effect of igneous emanations, and his remarks on this subject are worthy of very careful study. Some peculiar views are set forth on weathering and rock alteration, in which it is maintained that kaolin does not form during weathering and that kaolinization is mainly a hydrothermal process, a point of view long since left behind by American students of ore deposits. All these criticisms are overshadowed by the stimulating value of the book.

Personals

Sir Robert Hadfield has been elected president of the Faraday Society, London.

Mr. and Mrs. Willard S. Morse are at their new home at Chuquicamata, Chile.

John T. Fuller is beginning a three-months' visit to Arkansas, Kentucky and Utah.

Hon. Arthur R. Slipp has been appointed Minister of Lands and Mines for New Brunswick.

C. M. Weld has returned to New York after visiting some charcoal blast furnaces in Michigan.

George Wingfield, of Goldfield, recently underwent a surgical operation at San Francisco for throat trouble.

W. N. Thayer has recently returned to Cincinnati after making examinations of oil lands in southwestern Kentucky.

S. R. Wickett, of Toronto, has been chosen president of the Trethewey Silver Mines Co. of Cobalt in place of the late Col. Alex. M. Hay.

Frank Oliver is at Charleston, N. C., where he will make headquarters during the examination of mineral deposits in the interest of New York people.

F. R. Weekes will be in the West on development and examination work for the next two months. He will make headquarters at Darwin, Calif.

Dr. H. M. Payne has been appointed representative of the American Mining Congress at the Northwestern Mining Association meeting in Spokane, Feb. 19-24.

H. M. Kingsbury, lately with the South Ural Mining Co., a British organization operating in the Ural Mountains, Russia, has recently arrived at Victoria, B. C.

Garnett A. Joslin has completed his examination of the Dierks Lumber and Coal Co.'s land in Arkansas and Oklahoma, and is now at his office at Salt Lake City.

Frederick T. Teddy recently resigned his connection with the Tennessee Copper Co. to become mining engineer for the Adventure Consolidated Copper Co., of Greenland, Mich.

Samuel Mather, of Pickands, Mather & Co., Cleveland, and William G. Mather, Cleveland-Cliffs Iron Co., leave this week for California, where they will spend the remainder of the winter.

Edward L. Dufourq, who has "disappeared temporarily into Mexico," expects to return shortly to Mexico City and to then visit Pachuca. He plans to return to New York by the end of February.

Bayard S. Morrow has been promoted to be superintendent of the regrinding and flotation departments of the concentrator at the Anaconda company's Washoe works in Anaconda.

C. R. McCollom has established an office for consulting mining engineering work at Oatman, Ariz., and also will manage the Sunnyside Gold Mines Co.'s property and that of the Chicago Syndicate Mining Co.

Professor Rolla Clinton Carpenter, of Sibley College, Cornell University, has resigned, his resignation to take effect at the end of this academic year. Professor Carpenter will reach the age of sixty-five on June 26, 1917, the day before commencement

Francis B. Dutton has resigned as superintendent of the Lebanon, Penn., furnaces of the Bethlehem Steel Co. to become general superintendent of the Wharton Steel Co. plant at Wharton, N. J., recently acquired by J. Leonard Replogle and associates.

Adolph Knopf, of the United States Geological Survey, has gone to the Rochester district of Nevada, where he will spend three months in making a detailed geological survey of the small area in which the principal operations in that district are confined.

L. D. Gordon, manager of the Cerro Gordo mines in Inyo County, Calif., and the Round Mountain, in Nevada, who recently visited New York and other Eastern cities, has returned from a thorough inspection of the mines under his control and is in San Francisco.

Carl H. Fry, for nine years superintendent of the Yellow Aster mine at Randsburg, Calif., has resigned and is visiting San Francisco and the mining districts of central California. Mr. Fry made an exceptionally good record of production from the Yellow Aster and was foremost among mining men in the installation of safety devices for the protection of workmen.

Dr. W. F. M. Goss, for many years associated with the Schools of Engineering, Purdue University, and since 1907, Dean of the College of Engineering of the University of Illinois, has resigned that office, effective Mar. 1, 1917, to assume the presidency of the Railway Car Manufacturers' Association, an office to which he was elected on Feb. 1, subject to his release by the University authorities.

Elton W. Walker has resigned as superintendent of the Lake Copper Co. to devote his entire attention to the Mass and Adventure companies. He is succeeded at the Lake by C. E. Weed, who is thoroughly acquainted with the Lake situation, having been employed under Mr. Walker since work was resumed at the property two years ago. Mr. Walker is largely responsible for the successful work at the Lake and in Mr. Weed the company is fortunate in having a man who is best equipped by technical knowledge and practical experience to succeed him and to continue the profitable operation of the mine.

William L. Saunders has been elected a Class C director of the Federal Reserve Bank of New York. In place of Charles Starek, for the term ending Dec. 31, 1917. Mr. Saunders is chairman of the board of directors of the Ingersoll-Rand company and prominently identified with other business interests in New York City and New Jersey. He has twice been Mayor of Plainfield, N. J., a member of the New Jersey Harbor Commission, the New Jersey Board of Commerce and Navigation, president of the American Institute of Mining Engineers, and is now chairman of the U. S. Naval Consulting Board.

Obituary

Charles Alexander Canda, 47 years old, secretary of the Chrome Steel Works, at Chrome, N. J., died on Feb. 5 at his home, 564 Westminster Ave., following an illness of more than a month. Mr. Canda was born in New York, but had made his home in Elizabeth for the last eight years.

John Adams Church, who was one of the early graduates from the School of Mines, Columbia University, died Feb. 12 at his home, 697 West End Ave., New York. He was born in Rochester, April 5, 1843, and received the degree of engineer of mines from Columbia in 1867. From then until 1870 he studied in Europe; from 1872 to 1873 he was acting professor of mineralogy and metallurgy at Columbia, and at the same time was assistant editor of the "Engineering and Mining Journal." In later years he became one of the most prominent of American mining engineers. He was actively engaged at Tombstone, Ariz., and in the later 80's did important work in China for the Chinese government. Since 1890 he had been a consulting engineer in New York. He was a brother of Col. William C. Church, founder and editor of the "Army and Navy Journal." He leaves a son—John A. Church, Jr., who is metallurgical engineer with the Nichols Copper Co. We shall publish a fuller biographical notice of Mr. Church in a later issue.

Societies

American Association of Mechanical Engineers will hold its annual convention at Cincinnati, Ohio, May 21 to 24, inclusive. Committees in charge of arrangements are now planning the program for the four days.

American Institute of Mining Engineers, Montana Section; 62 members of the section assembled on the evening of Feb. 2 at the Silver Bow club at Butte, Mont., to hold their semi-annual meeting, preceded by an informal dinner. The election of officers for the ensuing year was the main business transacted. W. O. Siderfin was elected chairman, Oscar Rohn, vice chairman, E. B. Young, secretary-treasurer and C. D. Demond and F. W. Bacorn members of the executive committee. The retiring chairman, J. L. Bruce, addressed the meeting on the general activities of the Institute, being followed by L. D. Frink, superintendent of the North Butte Mining Co., who read a paper on the new ventilation system introduced in the company's mines, illustrating his paper by photographs taken in the mines and by specimens of the canvas tubing and the joints devised by the company's engineers. F. L. Linforth, of the geological department of the Anaconda Copper Mining Co. exhibited and explained maps and models, illustrating the graphical solution of many intricate geological problems. The meeting closed with a vivid description by B. H. Dunshee, of Anaconda, of his recent trip to the Hawaiian Islands.

American Institute of Mining Engineers—In an effort to increase the efficiency and life of guns constructed for the U. S. Government, members of the Naval Consulting Board will, during the next two weeks, meet with the American Institute of Mining Engineers for discussion of an important phase of this subject. The meeting will be in connection with the 114th convention of the Institute. Officers of the Army and Navy, Government representatives and other experts will be in attendance. The special subject to be discussed deals with the erosion of guns, or the hardening of the inner surface of the gun tube. The discussion will be opened with a paper by Dr. Henry Fay, of the Massachusetts Institute of Technology, which paper was prepared from a series of tests of metals made at the Watertown arsenal. A committee of the Naval Consulting Board, headed by Dr. Hudson Maxim, will be present at the Mining Engineers session and discuss the subject, after which the Committee will hold a meeting with technical experts in the rooms of the American Institute of Mining Engineers. The entire Naval Consulting Board has been invited to attend the meeting of the Institute and it is believed that the coming meeting will rank in importance with any in the 46 years of the Institute's history.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Aluminum—Production of Alumina and Potassium Sulphate from Alunite. Earl Blough and Thomas McIntosh, Pittsburgh, Penn., assignors to Aluminum Co. of America, Pittsburgh, Penn. (U. S. No. 1,214,991; Feb. 6, 1917.)

Ball Mill, Mortar. Leverett S. Ropes, Helena, Mont. (U. S. No. 1,213,264; Jan. 23, 1917.)

Cyanogen—Process of Making Cyanogen Compounds. Hans Foersterling and Herbert Philipp, Perth Amboy, N. J., assignors to The Roessler & Hasslacher Chemical Co., New York. (U. S. No. 1,214,770; Feb. 6, 1917.)

Crusher. Robert Eubank Leighton, Kingston, N. Y., assignor to Universal Road Machinery Co. (U. S. No. 1,214,693; Feb. 6, 1917.)

Crusher—Rotary Beater Mill. Thomas Joseph Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co. (U. S. No. 1,215,075; Feb. 6, 1917.)

Drill Mounting. Fred L. Emerson, Denver, Colo., assignor to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,214,527; Feb. 6, 1917.)

Drill Sharpening Apparatus. William A. Smith, Denver, Colo., assignor to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,214,604; Feb. 6, 1917.)

Electric Furnace for Fusing Metals. John Thomson, New York, N. Y., assignor to John Thomson Press Co., Jersey City, N. J. (U. S. No. 1,214,841; Feb. 6, 1917.)

Electrolytic Apparatus. William E. Greenawalt, Denver, Colo. (U. S. No. 1,214,775; Feb. 6, 1917.)

Electrolytic Reduction—Method of Reducing Metals. Robert J. McNitt, Niagara Falls, N. Y., assignor to the Roessler & Hasslacher Chemical Co., New York. (U. S. No. 1,214,808; Feb. 6, 1917.)

Hoist. Charles G. Palmer, Cleveland, Ohio. (U. S. No. 1,214,818; Feb. 6, 1917.)

Iron and Steel, Process of Making Iron and Steel. Sherwood S. Knight, Berkeley, Calif. (U. S. No. 1,213,806; Jan. 23, 1917.)

Leaching Apparatus—Apparatus for Extracting Values from Bodies. Richard Leslie Ogden, Rahway, N. J. (U. S. No. 1,215,182; Feb. 6, 1917.)

Magnetic Separation—Means for Effecting Magnetic or Inductive Separation of Substances. Samuel W. Osgood, Chicago, Ill. (U. S. No. 1,214,817; Feb. 6, 1917.)

Manganese Alloy—Method of Improving the Alloying Qualities of Manganese with Brass and Bronze. Hans Goldschmidt and Otto Weil, Essen-on-the-Ruhr, Germany, assignors to Goldschmidt Thermit Co., New York. (U. S. No. 1,214,539; Feb. 6, 1917.)

Metallurgical Machinery—Appliance for Sealing the Feed and Discharge Openings of Rotary Containers. John L. Malm, Denver, Colo., assignor to the Midwest Metals Co. (U. S. No. 1,214,809; Feb. 6, 1917.)

Ore Classifier or Separator. John N. Wingett, Denver, Colo. (U. S. No. 1,215,230; Feb. 6, 1917.)

Ore Reduction—Apparatus for Reducing and Metallizing Ores. Harmon N. Tracy, Los Angeles, Calif. (U. S. No. 1,214,844; Feb. 6, 1917.)

Pulverizer. William Kelsey Liggett, Columbus, Ohio, assignor to the Jeffrey Manufacturing Co., Columbus, Ohio. (U. S. No. 1,214,558; Feb. 6, 1917.)

Rock Drill. William Charles Stephens, Cornwall, England. (U. S. No. 1,214,607; Feb. 6, 1917.)

Rock Drill. Seymour Ferguson, Ocotlan, Mexico. (U. S. No. 1,214,665; Feb. 6, 1917.)

Shoveling Machine. Frank M. Hewitt, Goldfield, Nev. (U. S. No. 1,213,640; Jan. 23, 1917.)

Zinc Distilling Furnace, Electric, and Condenser for Producing Blue Powder. John Thomson, New York, assignor to John Thomson Press Co. Jersey City, N. J. (U. S. No. 1,214,842; Feb. 6 1917.)

Zinc Retorts—Method and Apparatus for Treating Zinc Bearing Materials. Charles A. H. de Saulles, New York. (U. S. No. 1,215,006; 1 215,007; Feb. 6, 1917.)

Editorial Correspondence

SAN FRANCISCO—Feb. 8

Mother Lode Mining Carnival is being planned by managers and superintendents of mines, the merchants' association and the Native Sons and Daughters. This proposed carnival is the outgrowth of a celebration held at Sutter Creek last year in honor of the reopening of the Old Eureka mine. At that celebration there were about 5000 people from various parts of Amador and adjoining counties, as evidence of the interest taken in the advancement of the mining industry. J. Walter Beam, manager of the Old Eureka, has been selected chairman of the organization and other prominent mining men have been selected as the officers, representing the principal mines of the Mother Lode. It is probable that the organization will be made permanent and that a similar carnival or celebration will be held every year.

New Geological Map of California, published by the State Mining Bureau, is ready for distribution at nominal prices representing actual cost—mounted on cloth and with molding for wall hanging, $2.50; unmounted $1. The geology by James Perrin Smith is represented in 23 colors and symbols. The map is 50x60 in., drawn by W. E. Condon to a scale of 1 in. to 12 mi. It represents two years of careful compilation of data from all available sources, both governmental and private, and includes much data heretofore unpublished, official and personal. An entirely new base map of the state was drawn and is up to date regarding boundaries, post offices, railroads, highways, roads, power transmission lines, oil pipe lines, aqueducts and other industrial improvements. The extraordinary amount of detail, not usual in a geological map, was placed in this map under the direction of Fletcher Hamilton, state mineralogist, because of the large demand by that branch of the mining industry directly interested in the economic as well as the geologic features of California mining regions.

A $1000 Monument for John H. Stowell is to be erected at the grave of this pioneer of the Shasta County copper region, who died 16 years ago about as poor as the average prospector and miner who "holds on to a good thing too long." Stowell's property, which was not much more than a partialy-developed prospect at the time of his death, sold two years ago, for approximately $200,000 and the Mammoth Copper Mining Co. is now developing a mine where Stowell wasted the later years of his life. He was a typical old-timer, who would not accept a $125,000 offer—a year or so prior to his death—because the prospective buyers would not bring the money in gold and lay it down on the dump. This is no fiction story. Stowell was either ignorant of values or unreasonably obstinate in respect to the sale of his property. He stated to the "Journal's" correspondent one day in the summer of 1899 that he had little faith in the intentions and purposes of the prospective purchasers. "If anybody thinks the mine is worth a damn," he said in concluding the interview, "let him bring the money and pile it up here on this board on the dump, so that I can see it." He would not trust the banks and did not believe the promoters meant business because they would not show the actual coin. Though he died, poor and friendless in his old age, there is now to be erected to his memory a $1000 monument. A bird in the hand is worth several in the bush and prospectors who are approaching the journey over the Great Divide might do well to consider this instance. It has many counterparts. Prospectors and owners in nearly every mining state are holding out for a price, one-quarter of which would maintain them in every comfort or luxury they could enjoy during the remaining span of their lives.

BUTTE—Feb. 8

Compensation-Law Report of the state industrial commission shows that up to Jan. 31, last, 1698 employers had enrolled under the act, bringing with them 56,434 employees. During the time the compensation law has been in operation, there has been paid out in compensation, medical and hospital fees $505,369, distributed among 2604 employees. The total number of accidents reported up to Jan. 31, 1916, was 11,465, of which 215 were fatal. The administration of the law during the time of its operation has cost the state $39,000, comparing favorably with the cost in other states where such a law is in effect.

New Important Litigations are confronting the Butte camp. The short breathing spell enjoyed by the Butte & Superior company since last spring is soon to be interrupted again by suits to be instituted against it by the Minerals Separation Co. and by the Clark interests, representing the Clark-Montana Realty and the Elm Orlu mining companies. The suit of the Minerals Separation Co. against Butte & Superior comes to trial on Mar. 19, in the U. S. District Court of Montana. The suit is based on the Hyde case and new evidence will likely be presented by the defendant company that may have a decided effect on the ultimate outcome. The question of damage due to the Minerals Separation Co. will be brought up. Tabulating the reports filed by defendants with the Montana court since 1913, the Minerals Separation Co. figures the value of flotation concentrates at over $16,000,000, the cost of which was about $1,000,000, leaving an apparent profit of $15,000,000, to part of which the plaintiff claims to be entitled. It will be up to the court to decide the amount of damages, if any, to be awarded to Minerals Separation. In addition to the Minerals Separation suit, Butte & Superior will also be called upon to face the new suit with the Clark-Montana Realty and the Elm Orlu Mining Co. As the result of recent development work, it is alleged, that the so-called Pyle strand of the Rainbow vein, apexes in the Elm Orlu ground and that therefore there is no warrant for claiming extralateral rights to orebodies beyond the "301" plane by which Judge Bourquin adjudicated conflicting interests last spring. The petition will be heard Feb. 10. In the petition it is also set forth that the Butte & Superior company has been mining ore from the ground in controversy at the rate of about 10,000 tons a month. An injunction restraining Butte & Superior from mining ore in the Pyle strand below its junction with the Rainbow vein and an accounting for the ore previously mined will be asked. If the injunction be granted, Butte & Superior would have to reduce its present output temporarily by about 20% until the completion of the new shafts will permit it to mine ore, developed in other sections of its own, undisputed territory.

DENVER—Feb 8

Merger of Cripple Creek Mines is reported to be in progress. Rumor states that A. E. Carlton is working on plans for merger of Elkton, Cresson, Portland, Golden Cycle and United Gold Mines.

Wet Concentration is not extensively practiced at Leadville. The reason for this as usually given is that most of the ores are suitable for smelting and that the district is well provided with custom smelting facilities. However, there is no doubt that the district contains large bodies of mineral-bearing materials that are not classified as ore but which might be mined and marketed profitably if subjected to some form of concentration. Cramer & Co., leasing a group on Carbonate Hill, close to town, are to construct a small mill to jig a low-grade lead material that has purposely been avoided for many years. The results may prove a valuable pointer to other leasers and owners.

SALT LAKE CITY—Feb. 8

Classifying Utah's Mineral Resources is to be undertaken on a comprehensive scale. A bulletin has been issued jointly by the Utah State Conservation Commission, the Utah State School of Mines, the Utah Chapter of the American Mining Congress—in coöperation with the U. S. Bureau of Mines—announcing and outlining work to be undertaken to allocate, classify, develop, and record the mineral resources of the State of Utah. It is planned to offer free determination of minerals, instruction in metallurgy, mineralogy, geology, and mining for prospectors, and to arrange for such steps as may properly be taken to bring owners of mineral deposits into touch with investors. It is not proposed to encroach in any degree upon fields now legitimately occupied by private interests. The object instead is to exercise functions not now discharged and to supplement where necessary the activities of private interests to develop the state's mineral resources. The Utah State Conservation Commission—a body created in 1909 and the members of which are appointed by the governor—has already done much valuable work in ascertaining and investigating the mineral and other resources of the state. A course for prospectors and others interested is being offered by the State School of Mines for the winter of 1916-17, and will afford five weeks' work, instruction being given in the fundamentals of metallurgy, mineralogy, geology of ore deposits, and mining. The object is to give prospectors such knowledge as will enable them to work to the best advantage in the field; to teach them how to determine the value of a mineral deposit, to dispose of the ore, to secure a purchaser for the property or to interest others in its development. The Utah Chapter of the American Mining Congress will assist in every possible way the work of mining prospectors, recognizing that all mining development has its inception in the activities of the prospector and appreciating that authoritative identification of mineral specimens will be of great value to prospectors. For the work, the State School of Mines contributes the use of its laboratories and the services of its faculty; the State Conservation Commission, the services of its office and field organization, including personal reconnaissance of mineral ground by its field secretary when necessary or desirable, and bears part of the laboratory expense; the Bureau of Mines, the services of its technical staff and organization; the Utah Chapter of the American Mining Congress, the facilities of its office and organization, sharing in the expense of printing, stationary, chemicals, and labor to make determinations of specimens submitted. Specimens may be sent for identification by mail or prepaid express, addressed to the Utah State Conservation Commission, room 412 Capitol Building, or to the Department of Metallurgical Research, University of Utah, Salt Lake City.

ROCHESTER, NEV.—Feb. 9

Greater Activity in Rochester is assured in the coming season. Besides the important development inaugurated by L. A. Friedman in the area between the Rochester Mines and the Nevada Packard properties, other new capital has entered the district. Noteworthy in this connection is the interest recently acquired by Clyde A. Heller, president of Tonopah Belmont, in the Rochester Merger Mines Co. of which he has become vice-president. The Nenzel interests, in addition to their mining operations, are preparing to install a water system in the towns of Rochester and Lower Rochester, pumping the water from springs in south American Cañon, on the east side of Nenzel Hill, and conducting it by pipes through the Nenzel-Crown Point workings, thence into and out of the Pitt-Nenzel tunnel on the Rochester side of the hill, through a raise that will connect these mine workings.

WALLACE, IDAHO—Feb. 6

Closing of the Mines Employment Office in Wallace on Jan. 31, marks the end of a notable chapter in the history of mining in the Coeur d'Alene district. It was the instrument that effectually broke the power of the Western Federation of Miners and prevented the organization from again becoming entrenched in the district, and while in recent years the system has been employed by only two companies, it has exercised a most wholesome influence in discouraging agents of the Federation in their efforts to restore the old régime. The discontinuance of the employment office is viewed with considerable apprehension by those who recall the conditions that prevailed prior to its establishment and the riot and disorder which brought it about. The Mines Employment Office, or the "permit system" as it was familiarly called when first adopted, was a measure adopted by the military authorities following the blowing up of the Bunker Hill & Sullivan mill in 1899. Shoshone County was placed under martial law by proclamation of the late Governor Steunenberg, and in order to free the mines from the disturbing element and those who were in sympathy with the Western Federation, the military authorities took charge of the employment of men for all the mines, established central employment offices in Wallace and Kellogg, and no one was allowed to go to work until he had received a "permit," to obtain which he had to pass through a rigid investigation to show that he was not affiliated with the Western Federation of Miners nor in sympathy with that organization. Upon the withdrawal of troops and the discontinuance of martial law, the system of employment was adopted by all the mining companies of the district with the exception of the Hercules. As applied by the companies the system was somewhat less rigid than was maintained by the military authorities but a close surveillance was exercised, and all who were known to be actively identified with the Western Federation of Miners or in sympathy with its methods were excluded from the mines. Members of the union who were known to be peaceable and law-respecting men were given employment, but the agitators and trouble-breeders were effectually barred through the methods adopted by the employment office. The power of the Federation was crushed and the local organizations were reduced to mere skeletons. As years passed new operating companies entered the field which had no connection with

the labor troubles and therefore did not join the system of employment, while other companies which had adopted the system passed out of existance for one cause or another. But the Bunker Hill & Sullivan, the Hecla and the Federal, which had absorbed the Standard, Mammoth and Morning mines, clung to the system of employment which had proved so effective in ridding the district of the disturbing element and the maintenance of which they regarded as a safeguard against a recurrence of the troubles of the past. However, upon the advent of Harry L. Day as president and general manager of the Federal Mining & Smelting Co., four years ago, the company withdrew from the employment office, leaving only the Hecla and the Bunker Hill & Sullivan. Upon the retirement of Mr. Day about a year ago it was expected that the Federal would again adopt the employment-office system, but definite announcement was made the latter part of January that the company would not come in again. It was then that the Bunker Hill & Sullivan and the Hecla companies decided to close the Wallace office, as it was being utilized only by the Hecla. The Bunker Hill & Sullivan company will continue the Kellogg office alone for the employment of men for itself and affilliated companies. The abandonment of the employment office by the Federal is believed to have some connection with the prospective litigation between the Bunker Hill & Sullivan and American Smelting and Refining Co., which controls the Federal, over the enforcement of the ore contract which will be set aside by the Bunker Hill & Sullivan when it begins smelting its own ore.

JOPLIN, MO.—Feb. 10

New Taxation for Joplin District is proposed. The war prosperity of the zinc producers has turned the attention of legislators in their direction, when looking for means to increase the revenues of the states. Both in the Missouri and Oklahoma legislatures, bills are pending to place a tax on zinc and lead ores. The measure introduced at Jefferson City provides for a tax of 4c. a ton on blende and lead ore and $^1/_{20}$c. on calamine. It is considered likely that this bill will be passed and become a law, with proper readjustment so as not to favor the calamine producers to the present extent. At Oklahoma City a bill has been introduced providing a 2% tax on the gross production of all ores. Zinc producers have sent representatives to the state capitol to fight this measure. They estimate it would take $200,000 from the Oklahoma field during 1917.

Title to Rich Zinc Land in the Oklahoma section of the district now hinges on a delicate legal point. Secretary of the Interior Lane has been called upon to decide whether Leander J. Fish, who died in November, 1914, owner of 200 acres of mineralized land north of Commerce, Okla., now valued at $500,000, was ever married to a Washington, D. C., woman, and whether she has a right to one-half his property despite the fact that she, believing he had divorced her, remarried. On the property is now located the Montreal and other rich zinc mines. Joseph Fish presumably has been the sole owner of the fee, and no one in this part of the country ever knew the senior Fish had ever married in Washington, on a business trip there about seven years ago, which is the claim.

TORONTO—Feb. 12

Most Interesting and Important Discovery in the Cobalt camp in several years is the way the recent discovery of silver on the 1600-ft. level of the Beaver mine is characterized in Canada's leading silver camp. While the major portion of the Beaver is not affected this new vein has an important bearing on the mines in the southeastern part of the camp. The rocks of Cobalt may be roughly divided into three classes: The conglomerate which is the principal ore-bearing formation; the Keewatin, a much older formation; and the diabase which is the youngest of all. The conglomerate was laid down on the Keewatin and these two formations were intruded by the diabase which occurs in the form of a sill. These formations were eroded by glacial action which laid bare the conglomerate that formerly was under the sill, and in this formation the most of the silver has been found. In the southeastern part of the camp, however, the conglomerate was thinner or the erosion was greater and the Keewatin was exposed, and only in this section of the camp has it been very productive. The Beaver and the Temiskaming mines decided to sink through the diabase sill which is about 1000 ft. thick and prospect the lower contact. In the other parts of the camp the Keewatin underneath the sill has not been especially productive and it was generally believed that the Beaver had little chance of encountering anything of importance. Fortunately, however, for the company and for the camp, the work at this level succeeded in opening a vein of high grade and since the first vein was found another parallel vein, 7 ft. away was cut. What effect this may have on the fortunes of the other mines in that section is of course an unknown quantity, but their speculative value has been much enchanced.

MELBOURNE—Jan. 9

Forty-four Hours a Week is now almost the universal rule throughout Australia and New Zealand for underground workers. Although in the recent Broken Hill Arbitration Court case, the employees undertook to produce as much ore in 44 hr. as previously in 48 hr., reports have not shown that this result has been attained. The tendency will undoubtedly be to eliminate Saturday work as far as possible and reduce the hours to 40, with pay as for 48, as a half-shift is not popular either with the manager or the men.

Bendigo Goldfield in Victoria is receiving renewed attention by reason of the proposal to combine a number of claims under one management. Certainly some action is necessary if the steadily diminishing yield of the Bendigo mines is to be counteracted. The gold output has shrunk in 10 years by no less than 111,000 oz. The results for 1916 were as follows: Production, 85,700 oz.; calls, £43,000; dividends, £13,275. The reason for the decline is not that the Bendigo reefs are exhausted—on the contrary many of them have hardly had a pick in them—but that the investing public has lost confidence in the district and declines to invest. The proposal is to amalgamate about 40 contiguous properties and to embark on a systematic policy of prospecting and equiping various properties located advantageously over the area to be worked. By the introduction of modern methods it is believed that considerable economies can be effected and that as compared with the present methods larger profits will be shown. The capital of the new company is to be £500,000 in 5s. shares. One million shares go to the shareholders of the companies being absorbed, and the other million are to be utilized for the financing of the prospecting operations.

The Mining News

ALASKA

ALASKA-JUNEAU (Juneau) — The mill is already so far advanced that it is expected that it will be completed in April, 1917.

ALASKA MEXICAN (Treadwell)—Mill ran 19 days 12 hr. in December, crushing 11,739 tons, yielding $18,234, or $1.56 per ton; operating expense, $20,457; operating loss, $2356; construction expense, $5284; loss. $7640; miscellaneous income, $3942.

ALASKA TREADWELL (Treadwell)—In the 300-stamp mill 150 were operated in December crushing 24,843 tons yielding $52,510 or $2.13 per ton; operating expenses, $29,924; operating profit, $22,585; construction, $14,444; net operating income, $8140; other income, $14,917; total net profit, $23,058. Stock of broken ore decreased 15,225 tons.

ALASKA UNITED (Treadwell) — Crushed in December in Ready Bullion mill 21,924 tons and in 700-Ft. Claim mill 22,050 tons yielding respectively $42,086 and $44,288, or $1.92 and $2.01 per ton. Ready Bullion operating expenses were $43,829; operating loss, $2163; construction expenses, $28,935; loss, $22,446; miscellaneous income, $1940. The 700-Ft. Claim operating expenses were $75,716; operating loss, $31,870; construction expenses, $7021; loss, $38,892; miscellaneous income, $1940.

ARIZONA

Cochise County

BISBEE COPPER MINING AND DEVELOPMENT (Bisbee)—Three-compartment shaft down 70 ft. Diamond drill down 740 ft., having gone through 50 ft. of sulphide below 610 ft. Machinery in place and operation expected in short time.

Greenlee County

SHANNON (Clifton)—January copper production was 759,000 lb.; decrease due to labor troubles; December output 977,000 lb. The 150-ton unit of leaching plant nearly completed; expected to be operating by end of February; President Amster states that if operation is satisfactory, plant will be enlarged to 1000 tons capacity for treating company's 1,000,000-ton tailing dump, and partly oxidized ore of Shannon Hill, estimated at from 3,000,000 to 5,000,000 tons. Developments in Leonard mine to depth of 450 ft. so satisfactory that new three-compartment shaft will be sunk to 600 ft.; mine now shipping about 125 tons daily.

Mohave County

BIG JIM (Oatman)—Crosscutting under way at 600-ft. level.

UNITED EASTERN (Oatman)—First shipment made of gold bullion from new mill; amounted to about 350 lb.

ADAMS (Oatman)—This prospect in Black Range section cut a 4-ft. quartz vein on 400 level.

CALIFORNIA

Amador County

TREASURE (Amador City)—Two men killed Feb. 5 by falling or being thrown from skip in winze below 1600 level.

BUNKER HILL (Amador City)—New tube-milling and concentrating plant in operation; working satisfactorily. Expect to make closer saving than formerly.

CENTRAL EUREKA (Sutter Creek)—Preparations being made for opening new level at 3350-ft. point; good ore disclosed at the bottom and also in crosscut on 2500 level.

CONSOLIDATED AMADOR (Sutter Creek)—Water lowered to 1300 level; from that point to the 2100 level, shaft is single compartment, so that unwatering will proceed more rapidly.

Calaveras County

GOLDEN WAVE (Angels Camp)—Purchased from W. D. Riley & Sons by Napa County men. Mill may be erected.

CALAVERAS COPPER (Copperopolis)—Reported that railroad extension from Milton, nearest station on Southern Pacific R.R., will be built to the mine and that it will be ready for handling freight before next winter. S. M. Levcy, superintendent, is now in Boston conferring with owners. Route will be via Salt Spring Valley reservoir and follow along west side of valley. Nine 16-horse teams are now employed hauling concentrates from mine to railroad at Milton, and carrying freight back to the mines. Milling capacity recently increased and deepening of three-compartment shaft from the 600 level to the 1000-ft. point is in progress.

Eldorado County

DARLING CONSOLIDATED (Georgetown) — New York men said to have become interested in this development.

PYRAMID (Rescue)—Shaft down to 700 ft. and 25 men are employed. Crosscut will be driven to tap the vein while shaft is being deepened.

MANGANESE CO. (Garden Valley)—Five carloads of chrome ore recently shipped by rail from Placerville to Pittsburgh. Ore hauled by teams to railroad.

Nevada County

ALLISON RANCH (Grass Valley)—Mill and cyanide plant are being constructed under superintendence of Frank A. Vestal, formerly with Empire mine. Installation of improvements and development of orebodies delayed by storm which blocked transportation by rail.

JERRY GOODWIN ESTATE (You Bet)—Final distribution ordered. Goodwin, owner of gravel mine, was killed in pistol fight two years ago. Annie M. Brown, of Maine, who bought out other heirs, will receive bulk of property. Nahum Goodwin, brother of decedent, is to be paid a monthly stipend for life and Adele Flint Kern, of Salinas, has been paid a bequest of $2500 for nursing Jerry Goodwin. Expected that mines will be operated without further interruption.

CHAMPION (Nevada City)—Reported that flotation will be tried and that material and machinery are on the ground for installation of plant. This will be the first trial to be given to flotation in Nevada County. Construction of aërial tramway across Deer Creek from the mouth of Providence shaft to the Champion mill will be started this month. By that time new station at 2700 level will be completed. Then all ore will be hoisted through Providence shaft and carried across creek to mill. About 150 men are employed.

Shasta County

MOUNTAIN COPPER (Keswick)—Capacity of flotation plant to be increased to 500 tons. Additions also being made to plant at Martinez. Reserves largely increased in the last year.

Siskiyou County

BLUE LEDGE (Medford, Ore.)—First shipment of copper ore hauled by teams to Jacksonville and loaded on freight cars. In the spring it is expected to increase shipments.

GRAY EAGLE (Happy Camp)—Eighteen bunkhouses, a dining room 18x70 ft., and other surface buildings under construction. Freighting in of machinery, lumber and other materials retarded by bad roads which would have been impassable to heavy loads if the company had not made

repairs. This expense added to 2c. per lb. for wagon freight makes shipping cost high. Development of additional ground on Clear Creek, 12 mi. below Happy Camp, and the Ely ledge on Elk Creek is also in progress. Diamond drilling to be done. William Koerner, superintendent.

Trinity County

LA GRANGE (Weaverville)—Reported that a siphon on Stewarts Fork and a section of 36-in. pipe was damaged by freezing and that operations are temporarily curtailed.

DEMOCRAT (Weaverville)—Work resumed by new owners, Junkins, Hanna & Ryan. Property is developed by a 300-ft. tunnel at 100 ft. below surface. Crosscut is being run to the ore.

Yuba County

A. B. C. MINE (Brownsville)—This property, formerly the Solano Wonder, is being operated by J. Hoeppner, an oil man. Property was equipped with 5-stamp mill and cyanide plant. The Clark mine adjoining also purchased by Hoeppner. Sinking to 400-ft. point in progress.

COLORADO

Boulder County

DEGGE-CLARK MILL (Boulder)—This tungsten reduction plant has resumed operations after short shut-down.

Dolores County

EMMA (Dunton)—Extensive development work being done by Tonopah Mining Co.

RICO ARGENTINE (Rico)—Drift being advanced into good-grade lead-silver ore containing copper and zinc.

Lake County

NISI PRIUS EXTENSION (Leadville)—Lessees have opened body of manganese ore on 180-ft. level; shipping 1000 tons monthly.

Park County

FIRE IN ALMA destroyed 18 buildings in business district including Redmen and K. of P. halls.

HOCKING MINE (Alma)—Operations suspended indefinitely.

San Miguel County

TOMBOY GOLD MINES CO. (Telluride)—Mill ran 29 days during January crushing 12,000 tons of ore which yielded $25,800 in bullion and $72,400 in concentrates, a total of $98,200. Operating expenses were $70,400, leaving an operating profit of $27,800, to which was added $1570 derived from other sources. Total profit, $29,370.

Summit County

KOKOMO METALS CO. (Kokomo)—First car lead-iron ore shipped recently. Regular shipments to be made in future.

MICHIGAN (Kokomo)—Large shoot good-grade lead ore being developed. Shipping retarded on account of car shortage. January production was 55 cars iron and lead ores.

WILFLEY (Kokomo)—Snow blockade of spur track to mine prevents shipping 15 to 20 cars ore but development work being continued. Upper tunnel being cleaned out and retimbered in preparation for further work.

GIBSON HILL (Breckenridge)—Car of lead-zinc ore shipped to smelting plant at Florence. Expected regular shipments will be made in future. Both milling and shipping grade ores being mined and considerable development work under way.

Teller County

LACKAWANNA BELLE (Cripple Creek)—Being operated by lessees.

DANTE (Victor)—Four sets lessees working on this Bull Hill property.

FIDELITY GOLD MINING CO. (Cripple Creek)—Stated rich strike made on this property which lies between Lackawanna Belle and Mt. Champion mines.

ELKTON (Victor)—Dumps at main shaft leased for two years to I. J. Russell, who plans to rough sort the ore and thereby raise average value of shipping product to about $6.00 a ton. Product will be shipped to the Golden Cycle mill at Colorado City.

GRANITE GOLD (Victor)—Bob Tail vein opened at 1600-ft. level of Dillon shaft, drift advanced 30 ft. in ore. Vein is 18 ft. wide and contains streaks of ore assaying $30 a ton. Ore shipped to Golden Cycle mill at Colorado City. C. C. Hamlin is general manager.

ROOSEVELT DRAINAGE TUNNEL (Victor)—One shift per day is being worked. Breast of tunnel is in the Comstock lode and approaching eastern end line of that claim. Small vein of quartz and fluorite, recently cut by tunnel, assayed $2.40 a ton. Tapping of this vein caused slight increase in flow of water from tunnel, which is about 9000 gal. per min. Charles Fuller, superintendent.

ALBERT BEACON GOLD MINING (Cripple Creek)—At recent meeting, following directors and officers were elected: Frank Vetter, president and treasurer; F. W. Revoice, vice-president; A. M. McVicar, assistant treasurer; J. D. Dunn, secretary; James Butler, assistant secretary; W. I. Seyman; and D. W. Kilpatrick. Shaft sunk additional 100 ft. recently. Considerable ore is being developed by lessees.

GEORGIA

BAUXITE MINING is active in the Andersonville district in Sumter County. Among the operators are Easterlin Brothers of Andersonville; Republic Mining Co. of Philadelphia, Penn.; Kalbfleisch Corporation of New York and Chattanooga, Tenn.

CHESTATEE (Brookton)—This cupriferous pyrite property being prepared for production by Nathaniel P. and George L. Pratt of Atlanta. Dam and 1000-hp. hydro-electric equipment being installed, and arrangements made for railroad branch from Brookton on Gainesville & Northwestern R.R.

IDAHO

Shoshone County

BUNKER HILL & SULLIVAN (Kellogg)—New smelting plant is about 65% completed. It is expected to be in operation about July 1.

JACK WAITE (Wallace)—Since ore shipments began 6 weeks ago, company has shipped 300 tons of ore averaging over 50% lead, with low silver content. Twenty men employed and shipments paying all expenses and providing surplus with which to build a mill in spring, according to the manager, Rush J. White.

COPPER KING (Mullan)—Diamond drill penetrated orebody several months ago. Drift being run to diamond drill hole has exposed 3 ft. of ore running from 30 to 40% lead and about 5 ft. of lower grade. Drift will reach drill hole in about two weeks. Ore in same shoot opened years ago about 1200 ft. above.

RAY-JEFFERSON (Wallace)—Beaver Creek branch of Oregon-Washington Railroad and Navigation Co. completed to Ray-Jefferson mill recently. Large accumulation of zinc and lead concentrates now being shipped and mill will begin running full time at 400-ton capacity. Property adjoins Interstate-Callahan on west. Large amount of ore available and company thoroughly equipped for steady operation.

AMBERGRIS (Wallace)—Rapid progress being made driving crosscut from No. 4 tunnel of Hercules north to cut Ambergris orebody at 1000 ft. below shaft, which is 200 ft. deep and shows two or three feet of high grade lead-silver ore. Aërial tramway from Hercules tunnel to be used to convey ore 1 mi. to the railroad. Ambergris controlled by Hercules.

BLACK BEAR (Wallace)—Meeting of stockholders authorized increase of capital stock from $1,250,000 to $2,000,000 with view to selling control. Meeting also authorized directors to borrow not more than $100,000 if desirable to provide mill and equip mine for operation. Property located on Cañon Creek near Black Bear, and has considerable lead and zinc ore blocked out.

KENTUCKY

IN THE ESTILL COUNTY OIL FIELD, considerable prospecting is being done under the direction of geologists. Last year a good showing was made by this field.

MICHIGAN

Copper

NORTH LAKE (Lake Mine)—Drifts on the new lode are encountering good rock.

NEW ARCADIA (Houghton)—Has found the lode sought and is drifting both ways.

ALLOUEZ (Allouez)—Shipping about 2150 tons per day to the mill; about capacity of mill.

MICHIGAN (Rockland)—Preparing to open its lodes; steps taken toward enlargement of shaft from two to three compartments for two-skip hoisting.

NEW BALTIC (Houghton)—New pump arrived and will be put in commission when shaft is 50 ft. below the ledge and sump constructed. Large amount of water in shaft has been delaying work.

OSCEOLA (Osceola)—Noticeable increase in tonnage over preceding month. Better ore coming from new ground opened at southern end of the old Osceola.

WYANDOT (Houghton)—On 10th level (bottom) has drifted 150 ft. in each direction. On the 9th level, each side has been stoped to the 8th level.

AHMEEK (Ahmeek)—Mill now has eight stamp heads in operation, six of which are of latest design. Seven heads treating Ahmeek rock with a daily average of over 5400 tons. Eighth head handling La Salle rock.

FRANKLIN (Demmon)—Electric rope-haulage system on 32d level will be in commission in about another month. The system on the 29th, 30th and 31st levels highly successful; rapid increase in tonnage as each was installed, taking care of the scarcity of trammers.

SOUTH LAKE (Houghton)—Good showings in the drift on third level on the Butler lode and on 6th level of the No. 3 North lode. On the South lode a drift is being extended beyond the boundary, connecting with the Lake workings, for ventilation. Daily tonnage, 175, yielding 18 lb. per ton.

INDIANA (Rockland)—Assessment of $1 levied payable Mar. 1. President R. M. Edwards states that since last April 700 ft. of development had been done on 1150 and 1400 levels; this work showed felsite mass to be of irregular shape; some native copper found near contact but no commercial quantities; No. 2 drill hole, which gave rich core, not encountered. A South Lake amygdaloid lode, on SW¼, Sec. 21, showing a little copper at surface, is being prospected; shaft down 160 ft.; will be sunk to 300 ft. when lateral work will be undertaken.

Iron

JONES & LAUGHLIN ORE CO. (Wakefield)—Seven diamond drills now at work. Shaft to be sunk and mine developed this spring.

HOLMES (Ishpeming)—Mine now connected with Sec. 16 shaft at depth of 1000 ft. Drifting started to ore. Concrete pockets put in underground.

OGLEBAY-NORTON (Ironwood)—General offices of this company for the Lake Superior district to be removed from Commonwealth, Wis., to Ironwood. E. H. Hopkins now at Ironwood.

WAUSECA (Iron River)—New concrete-lined shaft is to be sunk. It will be 21x7 ft. inside and 500 ft. deep. Osana shaft, owned by same company, to be concreted to depth of 500 ft.

MISSOURI

Joplin District

HONEY BEE (Joplin)—In good ore in new prospect on Banker's land near old Bumblebee property.

OSCEOLA (Joplin)—Erected 250-ton hopper over new shaft and will tram to mill. Plans for new concentrator temporarily abandoned.

ROANOKE (Commerce, Okla.)—Constructing new 350-ton mill short distance northeast of Commerce. Steam plant. E. M. Funkhouser, Commerce, manager.

CROCKETT (Joplin)—Opened good ore run at property formerly known as Lucky Joe at Four Corners. Fate Rhodes of Neck City, manager.

MATTES BROS. (Joplin)—Have leased and are operating Symmes mine southwest of city. Also have leased Dick Turpin near-by and will open it in about a month.

MISSOURI ZINC MINES CO. (Joplin)—Installed Pomona pump at Texmo shaft at Neck City. Will reopen mine and operate mill. Company also owns Quick Seven property which is shipping two carloads concentrates weekly from an opencut.

SCHOOLHOUSE (Joplin)—This mine at Carterville reopened by Chapman-Hosley Co. Mill remodeled and enlarged. Steam plant with 2600-ft. Sullivan cross-compound compressor, duplicate of one at Oronogo Mutual, which was largest in district. New feature is 37½-hp. oil engine to operate geared pump. Water hammer-drills replace old style, and mine formerly dusty in excellent sanitary shape.

Northern Arkansas

LIGHT SHIPMENTS IN JANUARY were reported from this field, the cold weather and bad roads being responsible. The total amounted to 39 cars, divided as follows: Rush, 10; Mt. Hersey, 16; Gilbert, 4; Zinc, 3; Ponca, 2; and Yellville, 1. J. C. Shepherd continued to be the largest operator, having shipped 18 cars.

MONTANA

Deerlodge County

ANACONDA (Anaconda)—Eighty-two electrical workers walked out Feb. 6 at the Washoe smeltery due to disagreement on the question of jurisdiction between the Electrical Workers' Union and the Mill and Smeltermen's Union. The controversy is still undecided. Temporarily, electrical machinery is kept running by members of the company's technical staff and volunteers from the Mill and Smeltermen's Union. On Feb. 7 the boilermakers walked out on the same ground taken by the electrical workers. On Feb. 9, all the men returned to work, the question of jurisdiction of the unions to be decided by arbitration.

Lincoln County

TROY DISTRICT is increasing its activities. A syndicate of Troy and Kalispell men have just taken over group of 15 silver-lead-zinc claims which they intend to develop under the title of Kalispell-Troy Mining Co. At the Montana Morning mine, owned by William Hogan and associates, development has started on a silver-lead-zinc vein; compressor is being installed. Togo Mining Co. is completing 4000-ft. flume and hydro-electric plant to supply power for development of orebodies exposed on company's properties. Big Eight, now controlled by the Day interests, has been considerably developed and more extensive operations are planned for coming season. On Silver Tip Extension, a $9000 contract was let last summer for crosscutting to reach promising orebody exposed on surface. Extensive development work is being done by the Troy Mining Co.; machine drills will be introduced as soon as Snowstorm company is prepared to furnish electric power. The old Keystone, Gold Flint, Jim Hill and Great Northern properties have been consolidated and financed by a Minneapolis syndicate. The copper zone in the eastern part of the county is assured considerable attention during coming summer.

Silver Bow County

BUTTE-DULUTH MINING CO. (Butte)—Bad weather and consequent tying up of acid shipments necessitated a shut-down of mine and mill

on Feb. 3; 100,000 lb. of copper have been shipped. Mines Operating Co. will also take over the Bullwhacker on Feb. 22, and continue operations now carried on by leasing syndicate. Ore running from 5 to 8% copper is now being taken out.

EAST BUTTE MINING CO. (Butte)—Output at Pittsmont smeltery during January was 1,479,520 lb. copper and 39,614 oz. silver. Development on 1800 level of Pittsmont mine shows orebodies to be better in quantity and quality than on upper levels. As soon as 1800 level is thoroughly opened up, shaft will be sunk to 2000-ft. level and lateral development work done.

NORTH BUTTE (Butte)—Company reports for quarter ended Dec. 31, 1916, surplus of $5,274,941, after paying quarterly dividend amounting to $322,500. Earnings for quarter were $808,072. Copper production for quarter was 6,729,561 lb.; silver 289,834 oz.; gold 500 oz. Total profit for 1916 was $2,467,524. Development work during quarter was as follows: Crosscuts 1534 ft.; drifts, 2521 ft.; raises, 2057 ft.; stations, 74 ft.; total 6186 lin.ft. During quarter mined and shipped 144,371 wet tons of ore and 16 wet tons of precipitates.

NEVADA

Clark County

SAN DIEGO (Nelson)—This Eldorado Cañon property, together with the Chicago and other claims, has been purchased by W. R. Letton and associates of Los Angeles, Calif., and shaft will be sunk to 500 ft.

Esmeralda County

CHAMPS D'OR GOLD MINING (Hornsilver)—On 350-ft. level, Dunfee lease, east drift encountered vein beyond the fault exposing several feet of shipping ore. Shipments will be confined to ore extracted in development with object of creating sufficient reserves to warrant erection of local treatment plant.

RED HILLS-FLORENCE MINING CO. (Goldfield)—The old Florence-American 800-ft. will be used as main hoisting shaft in present plan for development of property. A 50-hp. double drum hoist purchased and new headframe is being erected.

Humboldt County

HOME TRAIL (Rochester)—Property was recently purchased by Reno men and being developed.

ROCHESTER MINES (Rochester)—Towers for the new aërial tramway are completed and cables are being placed.

NENZEL-CROWN POINT (Rochester)—Long tunnel in American Cañon recently cut 5 ft. of ore in the Zero vein, supplementing the strike of sulphide ore in the Pitt-Nenzel tunnel.

ROCHESTER UNITED (Rochester)—Adit to develop downward extension of ore opened in 25-ft. shaft has cut the oreshoot. Another adit, known as the Silver King now being driven, should eventually tap this ground at 375-ft. depth.

NATIONAL MINES CO. (National)—Mill shut down in November, having treated 27,378 tons in 1916. Operations now confined to sinking main working winze to open three, new 150-ft. levels. Perry G. Harrison, superintendent..

HATCH MINING (National)—This company, leasing on the Buckskin-National company's ground, developed a considerable body of good-grade silver-gold ore. Six-stamp amalgamation and concentration mill erected but recoveries were unsatisfactory. Property now idle.

Nye County

TONOPAH ORE PRODUCTION for week ended Feb. 3 was 10,094 tons valued at $181,692, compared with 9266 tons for week previous. Producers were: Tonopah Belmont, 3171 tons; Tonopah Mining, 2400; Tonopah Extension, 2380; Jim Butler, 900; West End, 668; Rescue-Eula, 252; Halifax, 162; MacNamara, 54; Midway, 51; Montana, 50; miscellaneous, 6 tons.

TONOPAH EXTENSION (Tonopah)—Net profit for December was $51,220 from 8203 dry tons of ore; bullion production 1413 oz. gold and 141,097 oz. silver.

TONOPAH MINING (Tonopah)—Net profit for December was $61,000 from 7670 dry tons having average value of $17.65; bullion production was 134,990 oz. valued at $124,600.

RESCUE-EULA (Tonopah)—On 1050-ft. level cut vein that was a consistent producer on level above. Drifting east on full face of ore averaging about $20 per ton.

MONARCH-PITTSBURGH (Tonopah)—On 850-ft. level, west crosscut being run to connect with raise from 1000-ft. level. Early in February prospecting of oreshoot will be resumed.

NEW JERSEY

NEW JERSEY ZINC (Franklin Furnace)—Net profits in 1916 were $34,488,239; dividends $26,600,000; profit-sharing payments about $900,000.

NEW MEXICO

Grant County

CARLISLE MINING (Steeplerock)—New directors of this company are: August Heckscher, G. Maurice Heckscher, Sumner Gerard, Howard K. Welch and Sanford Makeever. Marcus Daly Estate not interested as previously reported; Marcus Daly, Jr., is a small stockholder but is not connected with the management.

UTAH

Juab County

TINTIC SHIPMENTS during January amounted to 802 cars; first week showing 195 cars; second week, 210 cars; third week, 212 cars; and fourth week, 185 cars. Shipments in last week curtailed by car shortage. In first week of February 211 cars were shipped.

YANKEE (Eureka)—Development concentrated at western end of property, following recent strike here, in search of Beck Tunnel ore.

TINTIC STANDARD (Eureka)—New shaft down over 400 ft. Ultimate depth to be at least 1500 ft. Blower on 1500 has improved ventilation. Shipments resumed.

OPOHONGO (Mammoth)—January and December shipments amounted to 3 cars for each month. Property has worked 20 years, having been developed without assessment; it has paid $71,900 in dividends; last payment in January, 1913, amounting to $9000 or 1c. a share.

Salt Lake County

MONTANA-BINGHAM (Bingham)—Contract for 900-ft. extension of tunnel by the Karns company nearly completed.

SOUTH HECLA (Alta)—There are 35 to 40 men working. Difficulty in getting ores to market owing to weather conditions.

UTAH APEX (Bingham)—Net proceeds in 1916 were $784,202, according to report filed with state board of equalization.

CONGOR (Bingham)—Sinking to meet raise from Montana-Bingham tunnel. Property produced car of ore daily during summer months.

UTAH COPPER (Garfield)—According to statement filed with state board of equalization, 1916 net earnings were $31,843,955; expenses, $18,345,603. Construction and repairs at plants cost: Magna mill, $120,438; Arthur mill, $535,399; leaching plant, $300,467; mines plant, $211,850.

MICHIGAN-UTAH (Bingham)—Orebody in crosscut from Lavina tunnel being explored; drifted on for 152 ft. and raise in ore up 35 ft.; extending upward and downward toward Copper Prince tunnel. January shipments about 20 cars. Ore accumulated at bins, owing to unfavorable weather conditions.

OHIO COPPER (Bingham)—Property recently inspected by President Hubert E. Rogers. Both Janney and Minerals Separation flotation systems to be tried out. Mill treating 2400 to 2600 tons of ore daily, averaging 1% copper. Recovery about 50%. Cash on hand, $250,000, with 2,000,000 shares of par value of $1 issued, and $500,000 shares in treasury.

Summit County

PARK CITY SHIPMENTS for January amounted to about 6943 tons, as compared to a little over 8000 tons in December, and 6750 in November. January shipments hampered by bad weather.

SILVER KING CONSOLIDATED (Park City)—New 50-ton mill giving satisfactory service. Thaynes Cañon tunnel in 1400 ft., daily progress of 12 to 13 ft. made; working two shifts; third shift to be added.

Utah County

MILLER MINES DEVELOPMENT (American Fork)—Organized by Kirk & Leavell, Salt Lake engineers, with a view to working old Miller mine, which made good production from upper workings.

CANADA

British Columbia

BRITISH COLUMBIA COPPER (Greenwood)—Copper production for month of January was 331,667 lb.

Ontario

ORE SHIPMENTS over the T. & N. O. Ry. for December, 1916, were: From Cobalt, Aladdin Cobalt, 22 tons; Beaver, 69; Buffalo, 32; Coniagas, 56; Cobalt Comet, 62; Crown Reserve, 91; Hudson Bay, 30; Kerr Lake, 94; La Rose, 44; Mining Corporation of Canada 107; McKinley-Darragh, 165; Penn-Canadian, 42; Trethewey, 38; Total, 854 tons. From Elk Lake, Miller-Lake-O'Brien, 20 tons. From Haileybury, Pittsburgh-Lorrain, 17 tons; Wettlaufer, 13 tons. Total silver ore shipments, 906 tons. From Porquis Junction, Alexo (nickel), 347 tons.

GIFFORD (Cobalt)—Capital stock has been increased from $250,000 to $1,000,000.

MINAKER (Kirkland Lake)—Narrow vein carrying free gold has been discovered.

HARGRAVES (Cobalt)—New vein 4 to 8 in. wide, carrying 2500 oz. per ton, has been struck in No. 1 shaft at the 75-ft. level.

CROWN RESERVE (Cobalt)—Vein of high-grade ore 4 in. wide said to have been struck on the 700-ft. level.

BOSTON CREEK (Boston Creek)—Plans for a mill the first unit of which will have a capacity of 175 tons of ore per day are in preparation.

DOME (South Porcupine)—In January, produced $181,000 worth of bullion from 89,600 tons of ore averaging $4.57 per ton, at a cost of $2.81 per ton.

McINTYRE (Schumacher)—Official figures give production during January as $115,297 from 14,317 tons of ore averaging $10.60 per ton. Average monthly production for the last quarter of 1916 was $118,764, average tonnage treated was 13,123 tons of an average value of $10.60.

BEAVER (Cobalt)—High-grade vein recently encountered on 1600-ft. level is said to carry 2000 oz. ore and wall rock carries silver for from 3 to 5 ft. on either side of the vein. (Later—At 7-ft. distance another high-grade vein was encountered.) Efforts being made to connect with the Temiskaming workings on the 1600-ft. level to improve the air circulation.

WEST DOME CONSOLIDATED (Porcupine)—Drift on 300-ft. level from the main shaft now in about 420 ft., and the vein which at first averaged $12 to $14 per ton is now said to average $34 per ton with an average width of 5 ft. A smaller vein 3 ft. wide, averaging $8 per ton was encountered, at right angles to the main vein.

MEXICO

JALISCO MINES in the Hostotipaquillo district have resumed operations, the principal difficulties being in securing supplies—especially cyanide. Cinco Minas has been milling 400 tons daily, Amparo, 300 tons, and El Favor and Mololoa are preparing to resume.

GREENE-CANANEA (Cananea, Son.)—January production 5,700,000 lb. copper, 156,690 oz. silver, 770 oz. gold.

MARGUERITE MINING CO. (Hunsicker Bldg., Allentown, Penn.)—J. S. Mack, president of this company, reports that installation of concentrating equipment for low-grade ore is contemplated; shipping high-grade to smelters. Property in Santo Tomas district in northern part of Baja California.

TRINIDAD

TRINIDAD LEASEHOLDS, LTD. (1 London Wall Buildings, London, Eng.)—At annual meeting, petroleum output for fiscal year ended June 30, 1916, reported as 120,060 bbl.; from July to November, 1916, it was 115,000 bbl. Shipping station at La Carriere with 8-in. submerged line working satisfactorily. Production mainly from Forest Reserve area; geological survey made of Guayaguayare area. Surrendered 7,500 acres of Crown land held under exploration license.

NICARAGUA

BABILONIA GOLD MINES, LTD. (La Libertad)—J. V. Lake has lately resumed charge after an absence of a year, on leave. Crosscut started from shaft for second level—120 ft. below main drainage level. Mill increased from 40 to 60 tons, and with two additional grinding pans it is hoped to mill 75 tons daily.

BRAZIL

SUMIDOURO GOLD MINE in the district of Ouro Preto, State of Minas Geraes, has been acquired under optional contract by a New York syndicate for whom Kirby Thomas is consulting engineer. An examination is now being made.

FRENCH GUIANA

SOCIÉTÉ-ANONYME DES GISEMENTS d'OR de SAINT ELIE (Sinnamary)—Report for 1915-16 shows 189 tributers worked at the company's Saint Elie placers and 30 at those of Adieu Vat. Yield for the year was 149,215.9 grams or an average of 12,235 grams monthly, as against 15,691 grams per month during the preceding year; this output includes also the production from the Couriège and Dieu Merci placers. Company's profit was about $15,000—entirely from merchandise sales; tributers' gold purchased at standard price.

BOLIVIA

CIA. MINERA Y AGRICOLA DE OPLOCA (Chocaya)—This company according to the "West Coast Leader," has doubled capitalization by issue of 60,000 more £1 shares, of which £28,000 are to be used at once for development campaigns at Tatasi and Portugalete silver-tin mines and at the Choroma silver mine. Company is owned by Chilean and Bolivian interests; was under option to North Americans last year but price was considered too high.

PERU

CERRO DE PASCO (La Fundicion)—Estimated January copper production, 6,172,000 lb.

SPAIN

PYRITES EXPORTS to the United States from Spanish and Portuguese ports in 1916, as reported by the Spanish agents of the Davis Sulphur Ore Co., amounted to 1,117,968 long tons, from various ports as follows: Huelva, 1,057,326 tons; Seville, 21,100; Pomarão (Portugal), 39,542 tons. Pyrites exports to the United States in 1915 were 874,920 tons and in 1914 were 854,432 tons.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—From 27,123 tons milled in December, the detailed returns were: Tabowie bullion, $33,903; Taracol, $33,558; Maibong, $28,597; Taracol cyanide-plant bullion, $63,593; Maibong tube-mill bullion, $4588; total, $164,240. Tabowie stamp mill crushed only 10,448 tons, owing to 20 stamps being hung up for 17 days during installation of four new mortars. Cage accident at Tabowie mine, Dec. 20, due to breaking of cable, resulted in death of 11 Koreans; followed by strike of contract miners for higher pay; strike broken by Dec. 27. Hydro-electric plant closed on Dec. 21; using some steam, and electric power purchased from Okura & Co.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Feb.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
8	4 7550	77½	37 15/16	12	.....	...	38 1/16
9	4.7550	77⅜	37⅞	13	4.7544	79	38 1/16
10	4.7540	77⅜	37⅞	14	4.7544	78⅜	38⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	30¾		8¼	8¼	9¾
8	@31¼	54½	@8⅜	@8⅜	@10¼
	31		8⅜	8⅜	9¾
9	@32	54	@8⅜	@8⅜	@10¼
	31		8⅜	8⅜	9¾
10	@32	54	@9	@9	@10¼
12	.....	...	...	...	.....
	31½		8½	8½	9¾
13	@32¼	53	@9	@9	@10¼
	31½		8½	8½	9¾
14	@32¼	53	@9	@9	@10¼

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies; and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Feb.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
8	137	133	146	200¾	201½	30½	47
9	138	134	147	200½	201¼	30½	47
10	....	....	....	....	....	....	....
12	138	134	147	200¾	201¼	30½	47
13	138	134	147	199½	199	30½	47
14	140½	136½	....	....	....	30½	....

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 643c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

NEW YORK—Feb. 14, 1917

All of the metals were strong last week, but the volume of business was small. Freight difficulties continued to be a troublesome factor. There is a large demand for both copper and lead for near-by deliveries, which cannot be supplied.

Copper, Tin, Lead and Zinc

Copper—More business was reported than in the previous week, there being transactions by producers each day, but, of course, the aggregate was relatively small and represented only such copper as could be scraped up to help regular customers. Even this business was sufficient to stiffen prices further, but producers were moderate and did not demand as much as they could have obtained. There were reports of transactions outside of the regular channels together with some interesting conjectures, at higher prices. With the situation existing in this market anything may be believed.

The business done by producers was mainly for April-June and May-June delivery, but there were some sales for July, which toward the close of the week realized 31½c., r.t. Heretofore, buyers have had scarcely any interest in deliveries later than June and that they should have begun nibbling for July is significant.

There is undoubtedly an unsatisfied demand of considerable proportions for copper this side of July, which is evinced by the nature of the inquiries. In part, these come from manufacturers who have not yet covered themselves; in part, they are from manufacturers who have opportunities to take new business and are sounding for their raw material. Being unable to get the latter, they will naturally be unable to take the business offered to them.

Copper refiners are still troubled in getting their raw material from the West, the railway congestion being especially in the Chicago district. Arrangements have been made, however, to bring copper hither by a roundabout way.

Exports from Baltimore included 154 tons brass sheets and disks to Italy.

Copper Sheets—Base price for copper sheets continues unchanged. The quotation is 42c. for hot rolled and 43c. for cold rolled. Wire is quoted on a base of 37c. f.o.b. mill.

Tin—On Thursday and Friday good business continued to be done, but after the holiday the market became dull. At the opening of the week, spot was quoted at 54½c., futures at 47¾c. At the close, spot was 53c. and futures, 47c.

Lead—Conditions in this market are so entirely at sixes and sevens that our quotation of it is more or less nominal. There is still a large demand for February and March lead, but it is not to be had in any considerable quantities. Some large buyers who were inquiring for supplies last week simply had to be turned away and they made up their minds that they could not get what they needed, no matter what they might have been willing to pay. As early as Thursday, Feb. 8, 8½c. was paid for February lead in St. Louis, while 8¾c. was reported as being paid in Pittsburgh. Later, 9c. was actually paid in St. Louis and 9¼c. in New York. Although business was done in 100-ton lots at such prices, the total was relatively small, the supply not being available to permit it to be otherwise. The A. S. & R. Co. raised its price to 8½c. on Feb. 9, but an independent producer had already realized 8¾c. on the same day. Producers are in a position to sell for April delivery, but buyers are not much interested that far ahead.

Spelter—Only a moderate business was reported, and that at not much change in price. There is not the same kind of strength in this metal that there is in copper and lead. In them there is real strength, based on the statistical positions. In spelter there is a sentimental strength, based on possible political developments.

Zinc Sheets—No change has been made in the market price of zinc sheets. Quotation is $21 per 100 lb., f.o.b. Peru, less 8% discount.

Other Metals

Antimony—In the first half of the week the market was quoted at 30c., but the turnover was small, probably not more than 25 tons. Owing to the scarcity of supplies, however, very small buying orders had been sufficient to advance the market. The arrival of 300 tons from the far East eased the situation and on Tuesday and Wednesday the market was quoted at 28c. February-March shipment from China was quoted at 15@16c., c.i.f., New York, duty unpaid, right through the week.

Aluminum—The aluminum market continues quiet, with buyers scarce. Nominal quotations are at 58@60c. per lb. for No. 1 ingots, New York.

Nickel—No change appears in nickel quotations. Price remains at 45@50c. per lb., with electrolytic commanding an additional 5c.

Quicksilver—The situation is unusual in that there is practically no stock in New York and buyers, though few, are paying what they have to. Sales are reported from $125 to $150, but dealers are said to be supplying regular customers at $125. We quote $125. San Francisco reports, by telegraph, $125, steady.

Gold, Silver and Platinum

Gold—Gold coin amounting to $510,000 has been withdrawn from the subtreasury for shipment to South America. Gold coin to $370,000 has also been withdrawn for shipment to Cuba and $20,000 for shipment to Mexico.

Under date of Jan. 25, 1917, Samuel Montagu & Co., London, reports the London "Times," on Jan. 20, announced that the board of trade had authorized the distribution of certain quantities of gold for the pottery industry under condition that the gold must be employed directly and exclusively for the decoration of pottery ware intended for export from Great Britain.

A recent Reuter telegram from Delhi stated that the government has announced its intention to sell gold bullion weekly as from Jan. 18 through the Bank of Bombay. The government reserves its discretion regarding the amount, but anticipates that the value sold will average half a million sterling.

The shipment of $25,000,000 in gold which arrived from Canada for account of J. P. Morgan & Co. was the first shipment of importance to arrive here since Jan. 11, when $24,400,000 was received. Since the beginning of the present calendar year we have imported from all sources about $82,500,000 gold, and since January, 1915, about $1,220,000,000.

Silver—Speculative operations had been in force for a decline in the price of silver based on the pressure of peace news to bring down the price of silver, but peace news proving to be a myth not likely to be materialized soon, covering of bear sales and short supplies have stiffened silver to the highest price it has reached since 1893.

Under date of Jan. 25, 1917, Samuel Montagu & Co., London, reports that the cessation of sales from China, and the paucity of supplies from America had imparted considerable steadiness to the market. At one time the entry of Indian Bazaar buyers to cover bear sales, caused an apprehension that, on so starved a market, the price might be forced up considerably, but when 37¼d. was reached on Jan. 22, competition eased off. This quotation is ⅛d. higher than any recorded during the war and a fresh record since 1893.

On Dec. 8 the following enactment was made in Hongkong: "Rule 37—No person shall export without the special permission of the superintendent of imports and exports, or attempt to export or procure for the purpose of exportation, any silver dollars or silver bullion."

Mexican dollars at New York, Feb. 8, 59¾@62¾c.; 9, 59⅞@62⅞c.; 10, 60@63c.; 13, 60@63c.; 14, 61⅛@64⅛c.

Platinum—Demand continued steady. We quote $105 per oz.

Palladium—Quoted at $90 per oz.

Zinc and Lead Ore Markets

Platteville, Wis., Feb. 10—Blende, basis 60% Zn, $87 for premium ore down to $85 for medium grades. Lead ore, basis 80% Pb, $96 to $100. Shipments for the week are 2509 tons of zinc ore and 353 tons of sulphur ore. For the year to date the figures are: 15,433 tons of zinc ore, 402 tons of lead ore and 2860 tons of sulphur ore. Shipped to separating plants during the week, 3024 tons of zinc ore.

Platteville, Wis., Feb. 3—Blende, basis 60% Zn, $75@80 for premium ore down to $72 for medium grade.

Platteville, Wis., Jan. 27—Blende basis 60% Zn $85 for premium down to $80 for medium grade.

Joplin, Mo., Feb. 19—Blende, high, $91.80 per ton; basis 60% tin, $80@90. Calamine, value 40% Zn, $50@55. Average selling price all grades of zinc, $83.40. Lead ore, high, $105.30, basis 8% Pb, $98@100. Average selling price all grades of lead, $98.21.

Shipments for the week: Blende, 6698 tons; calamine, 608 tons; lead, 1446 tons. Value, all ores for week, $751,320.

Demand for zinc ores was as strong this as it was weak last week, with the return of $90 base prices. Lead prices continue to climb in a manner satisfactory to producers. Zinc-smelting companies, formerly dependent most largely upon Western zinc ores are gradually increasing their purchases in this district. This sustains a report prevalent here that Western ore production must be increasingly restricted. Further delays in repairs to the electric company's power plant is restricting the output of this district, conservatively estimated, from 3000 to 4000 tons per week less than the present mill equipment could produce.

Joplin, Mo., Jan. 27—Blende, high, $92.15; 6% Zn, premium ore $90, medium, $87.50@85; low, $82. Calamine, per ton 40% Zn, $50. Average selling price all grades of zinc ore, $84.46 per ton.

Joplin, Mo., Feb. 3—Blende, basis 60% Zn, high, $82.45, medium $70@80. Calamine, 40% Zn, $50@55. Average selling price all grades zinc ore, $80.13.

Other Ores

Tungsten Ore—Negotiations with foreign buyers who wanted spot delivery of ore, resulted in fair orders being placed. Further orders are being negotiated. We quote the market at $17, at which business was done last week. Owing to the political uncertainties the situation is difficult to gage.

The Wah Chang Mining and Smelting Co. is now producing high-grade tungsten concentrates in China, and is exporting both to England and America. The ore is shipped in iron-bound wooden cases, containing 220 lb.

Uranium Ore—Unchanged. Carnotite ore at $3.25 per lb. of U_3O_8.

Other Minerals

(Quoted by Foote Mineral Co., for car lots, Philadelphia.)

Barytes—Crude sulphate is firm at 1¼c. for floated bleached white grade; off color, remains at $18 per net ton and commercial lining at $10 per ton.

Magnesite—Raw firm at 1¼c. per lb. for California, ¾c. higher for Grecian.

Tantalite—The 65% Ta_2O_5 compound unchanged at $15 per unit.

Thorianite—Only small lots available for spot delivery at $7 per lb. of ThO_2.

Lepidolite—The 4% oxide is at 1¾c. per lb.

Ilmenite—The 50% oxide is firm at 45c. per unit.

Zirkite—77.5% oxide at 6c.

Iron Trade Review

NEW YORK—Feb. 14

Cold weather has added to the trials of insufficient cars and locomotives and, gaged roughly, 25% of the producing capacity of the Central West in pig iron and semifinished and finished steel is idle, according to the estimate of "Iron Age." About 30 blast furnaces of the Steel Corporation are banked and more may follow. The industry cannot push out product against lines of standing loaded cars nor can it get steady inflow of materials if empty cars do not reach sources of supply.

In a word, the railroad situation is all absorbing. It is developing a pronounced spot market, particularly in pig iron Prices on most grades of iron have been advanced, from 50c. per ton in some markets and $2 on foundry iron in Pittsburgh, where there has been a spread between prompt and future of fully $5. Basic alone has not responded, domestic sales bringing a shading of $30 at Valley furnace, but the general falling off in production is regarded as a check. Export purchases of basic include 20,000 tons for Italy at $32 to $32.50, seaboard, for April delivery, and 5000 tons at $31, Valley furnace.

Steel consumers are concerned over the uncertainties of deliveries and increasing activity in negotiations for second-half buying is noted. The increased Government naval program, adding three more battleships, one battle cruiser, 15 destroyers and 18 submarines, makes a disturbance of mill delivery schedules more likely. Prices are naturally sensitive, and the next two or three months curtailment in output is calculated to hold, if not to stiffen, present levels through the second half and possibly through the entire year.

France, as well as England, is now seeking boats. Besides trying for existing ships, negotiations are under way to take over contracts for ships under construction. It is believed that six have already been bought and new contracts have been placed, contingent solely on securing the material. Three of the new ships are to be built in San Francisco. For oil tanks in Mexico some 7500 tons in plates is wanted.

So far the Government's purchases, outside of shapes for navy yard buildings, cover only large shells. A domestic shell maker has been sounding the market on 2000 tons of shell steel billets for March and April.

Iron Ore

Ore shipments from Lake Erie docks to furnaces in January, according to "Iron Age," were 686,277 tons, which is 201,149 tons, or 22½%, less than the shipments of January, 1916. While the reduced movement is attributable in part to car shortage, stocks at furnaces were larger at the close of the navigation season than was the case a year before. The stocks on the docks on Feb. 1 were 9,118,926 tons, which is 2,047,651 tons greater than the dock supply on Feb. 1, 1916, and it is expected that on Apr. 1 there will be more ore available at Lake Erie ports than on the same date in 1916.

Imports at Baltimore included 2823 tons of iron ore from Spain.

STOCK QUOTATIONS

N. Y. EXCH.†	Feb. 13
Alaska Gold M.	7⅛
Alaska Juneau	7
Am.Sm.&Ref.,com.	97⅛
Am. Sm. & Ref., pf.	112⅝
Am. Sm. Sec., pf. A	98⅛
Am. Sm. Sec., pf. B.	96
Am. Zinc	36⅛
Am. Zinc, pf.	66
Anaconda	76⅛
Batopilas Min.	1⅛
Bethlehem Steel	391
Bethlehem Steel, pf.	116½
Butte & Superior	45
Chile Cop.	21⅛
Chino	54⅛
Colo.Fuel & Iron	43
Crucible Steel	65⅛
Dome Mines	20
Federal M. & S.	11⅛
Federal M. & S., pf.	39⅛
Great Nor., ore ctf.	32⅛
Greene Cananea	42
Homestake	126
Inspiration Con.	55⅛
International Nickel	41⅛
Kennecott	43⅛
Lackawanna Steel	77
Miami Copper	37⅛
Nat'l Lead, com.	54
National Lead, pf.	110
Nev. Consol.	23⅛
Ontario Min.	6⅛
Quicksilver	2⅛
Quicksilver, pf.	2⅛
Ray Con.	25⅛
RepublicI.&S.,com.	76
Republic I. & S. pf.	101⅛
Sloss-Sheffield	60
Tennessee C. & C.	15⅛
U. S. Steel, com.	106⅛
U. S. Steel, pf.	117
Utah Copper	107⅛
Va. Iron C. & C.	48⅛

N. Y. CURB†	Feb. 13
Buffalo Mines	1.45
Butte & N. Y.	1⅛
Butte C. & Z.	9⅛
Caledonia	.58
Can. Cop. Corpn.	1⅛
Carlisle	5⅛
Cashboy	.06
Cerro de Pasco	39⅛
Con. Ariz. Sm.	2
Con. Coppermines	3⅛
Con. Nev.-Utah	⅛
Crystal Cop.	1 7/16
First Nat. Cop.	⅜
Florence	‡.70
Goldfield Con.	.65
Goldfield Merger	.08⅛
Granite	.12
Hecla Min.	7 11/16
Howe Sound	7⅛
Jerome Verde	1 5/16
Joplin Ore & Spel.	.32
Kerr Lake	4⅛
Magma	50⅛
Majestic	⅛
McKinley-Dar-Sa.	.53
Mother Lode	.39
Nevada Hills	.22
N. Y. & Hond.	15
Nipissing Mines	8
Ray Hercules	4
Rochester Mines	.60
St. Joseph Lead	19
Standard S. L.	.75
Stewart	.25
Success	.40
Tonopah	6⅛
Tonopah Ex.	4⅛
Tribullion	‡1 1/16
Troy Arizona	.52
United Verde Ext.	35⅛
United Zinc	3⅛
White Knob, pf.	1⅛
White Oaks	2
Yukon Gold	2

SAN FRAN.*	Feb. 13
Alta	.04
Andes	.18
Best & Belcher	.03
Bullion	.02
Caledonia	.18
Challenge Con.	.04
Confidence	.05
Con. Virginia	.08
Gould & Curry	.03
Hale & Norcross	.06
Jacket-Cr. Pt.	.02
Mexican	.16
Occidental	.65
Ophir	.06
Overman	.03
Savage	.05
Seg Belcher	.02
Sierra Nevada	.10
Union Con.	.41
Utah Con.	.01
Belmont	4.50
Jim Butler	.75
MacNamara	.06
Midway	.17
Mont.-Tonopah	.21
North Star	.13
Rescue Eula	.26
W.-t End Con.	.62
Atlanta	.13
Booth	.10
Comb. Frac.	.04
D'field B.B.	.02
D'field Daisy	.03
Florence	.23
Jumbo Extension	.30
Kewanas	.16
Round Mountain	.41
Silver Pick	.16
Argo	.05
Ariz. Central	.10
Big Jim	1.25
Lazy Boy	.05
Nellie	.18
Tom Reed	1.87½
United Eastern	4.00
United Western	.02

BOSTON EXCH.*	Feb. 13
Adventure	3
Ahmeek	97
Algomah	.99
Allouez	61½
Ariz. Com., ctfs.	13⅛
Bonanza	.30
Butte-Balaklava	1⅛
Calumet & Ariz.	78⅛
Calumet & Hecla	545
Centennial	20
Copper Range	62⅛
Daly West	2⅛
Davis-Daly	5⅛
East Butte	13⅛
Franklin	7⅛
Granby	80
Hancock	15⅛
Hedley	16
Helvetia	.45
Indiana	1⅛
Island Cr'k, com.	61
Isle Royale	32⅛
Keweenaw	3⅛
Lake	13⅛
La Salle	3⅛
Mason Valley	5⅛
Mass	12⅛
Mayflower	2⅛
Michigan	2⅛
Mohawk	80
New Arcadian	4⅛
New Idria	15⅛
North Butte	20⅛
North Lake	1⅛
Ojibway	2⅛
Old Colony	2⅜
Old Dominion	60
Osceola	85
Quincy	88
St. Mary's M. L.	79
Santa Fe	1⅛
Shannon	8⅛
Shattuck-Ariz.	26
So. Lake	4⅛
So. Utah	.25
Superior	14
Superior & Bost.	6⅛
Tamarack	56⅛
Trinity	4
Tuolumne	1⅛
U. S. Smelting	56
U. S. Smelt'g, pf.	50⅛
Utah Apex	2⅛
Utah Con.	19
Utah Metal	5
Victoria	5⅛
Winona	4
Wolverine	47
Wyandot	1

BOSTON CURB*	Feb. 13
Alaska Mines Corp.	1⅛
Bingham Mines	8
Boston Ely	.35
Boston & Mont.	.66
Butte & Lon'n Dev.	.20
Calaveras	4⅛
Calumet-Corbin	.01
Chief Con.	1⅛
Cortez	.30
Crown Reserve	.35
Eagle & Blue Bell	1⅛
Houghton Copper	
Iron Cap Cop., pf.	16⅛
Mexican Metals	.25
Mines of America	1⅞
Mojave Tungsten	.76
Nat. Zinc & Lead	.59
Nevada-Douglas	1 11/16
New Baltic	2⅛
New Cornelia	17
Ohio Copper	1⅛
Oneco	.70
Pacific Mines	.35
Rex Cons.	.32
Rilla	.03

SALT LAKE*	Feb. 13
Big Four	.77
Black Jack	.08
Cardiff	4.00
Colorado Mining	.15⅛
Crown Point	.04
Daly-Judge	8.50
Emma Cop.	1.43¾
Empire Copper	1.90
Gold Chain	.13⅛
Grand Central	.50
Iron Blossom	1.25
Lower Mammoth	.04⅛
May Day	.09⅛
Moscow	.16
Prince Con.	1.20
Seven Troughs	.03¾
Silver-King Coal'n.	3.10
Silver King Con.	4.00
Sioux Con.	.12
So. Hecla	1.30
Uncle Sam	.04
Wilbert	.11
Yankee	12½

TORONTO*	Feb. 13
Bailey	.05
Beaver Con.	.48
Chambers Ferland	.13⅛
Coniagas	4.10
La Rose	.50
Peterson Lake	.10
Right of Way	.05
T. & Hudson Bay	.59 .50
Temiskaming	.58
Wettlaufer-Lor.	.06⅛
Dome Exten.	30⅛
Dome Lake	.30
Foley O'Brien	.70
Hollinger	6.50
Jupiter	.30
McIntyre	1.92
Newray	1.10
Porcu. Crown	.68
Schumacher	.68
Vipond	.51
West Dome	.32½

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Feb. 13
Cresson Con.	6.50
Doctor Jack Pot	.08⅛
Elkton Con.	.10⅛
El Paso	.30
Findlay	.06¼
Gold Sovereign	.05
Golden Cycle	2.47
Granite	.58⅛
Isabella	.20
Mary McKinney	.25
Portland	1.85
Vindicator	1.10

LONDON	Jan. 30		
Alaska Mexican	£0	12s	6d
Alaska Tre'dwell	2	10	0
Burma Corp.	3	16	3
Cam & Motor	0	9	6
Camp Bird	0	5	6
El Oro	0	7	0
Esperanza	0	8	0
Mexico Mines	4	2	6
Nechi, pfd.	0	12	9
Oroville	0	15	0
Santa Ger t'dis	0	8	6
Tomboy	1	0	0

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755		22.753	26.975	
March	50.241	57.935		23.708	27.597	
April	50.250	64.415		23.709	30.662	
May	49.915	74.269		23.570	35.477	
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.265		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan.	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440		102.667		133.167	
Mar.	26.310		107.714		136.000	
April	27.895		124.319		137.389	
May	28.625		135.457		152.522	
June	26.601		112.432		137.455	
July	23.865		95.119		125.500	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct.	27.193		122.750		142.523	
Nov.	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717		181.107	
March	50.741		193.609	
March	51.230		199.736	
May	49.125		196.511	
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av. year	43.480		182.096	

Lead	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246		6.164		31.988	
March	7.136		7.375		34.440	
April	7.630		7.655		34.368	
May	7.463		7.332		32.967	
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.858		6.777		31.359	

Spelter	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
Jan.	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420		18.260		97.762	
Mar.	16.846		16.676		95.048	
April	16.695		16.525		99.056	
May	14.276		14.106		94.217	
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept.	8.990		8.820		52.095	
Oct.	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. ‡ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1916	1917	1916	1917
January	$21.60		$18.78		$19.70	
February	21.16		18.93		19.51	
March	21.81		19.20		19.45	
April	21.65		18.95		19.45	
May	21.78		19.11		19.58	
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.